SCIENTIFIC AMERICAN

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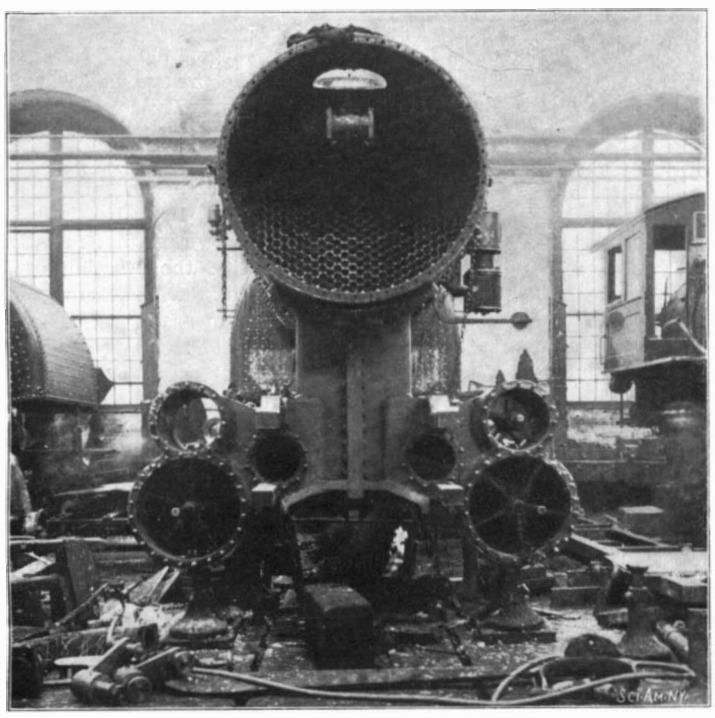
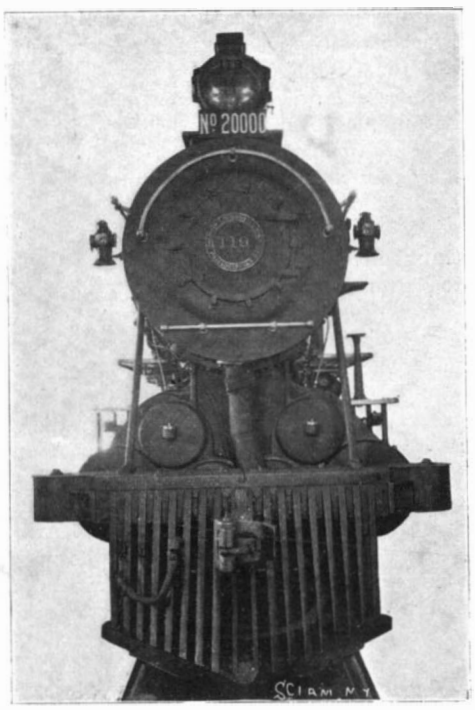
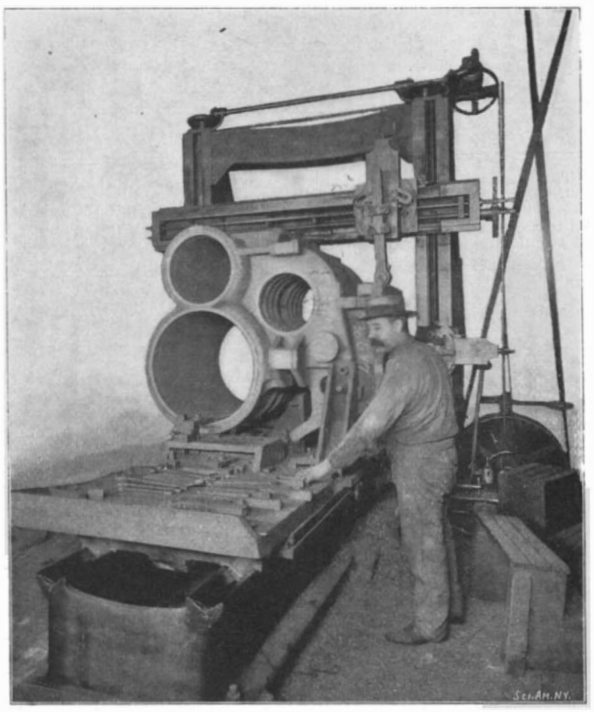


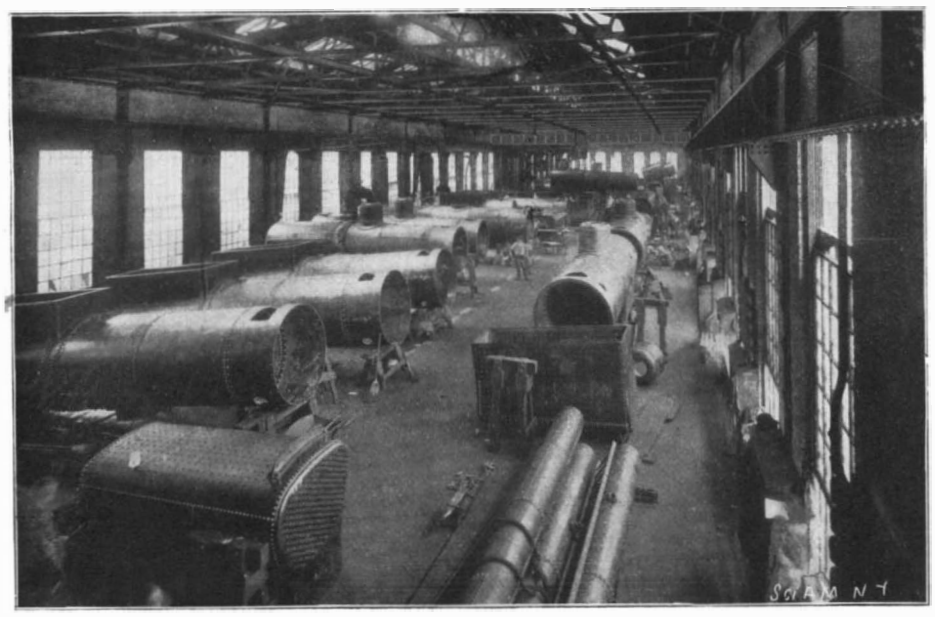
Second Stage of Locomotive Erection: Cylinders, Frames and Boiler in Place.



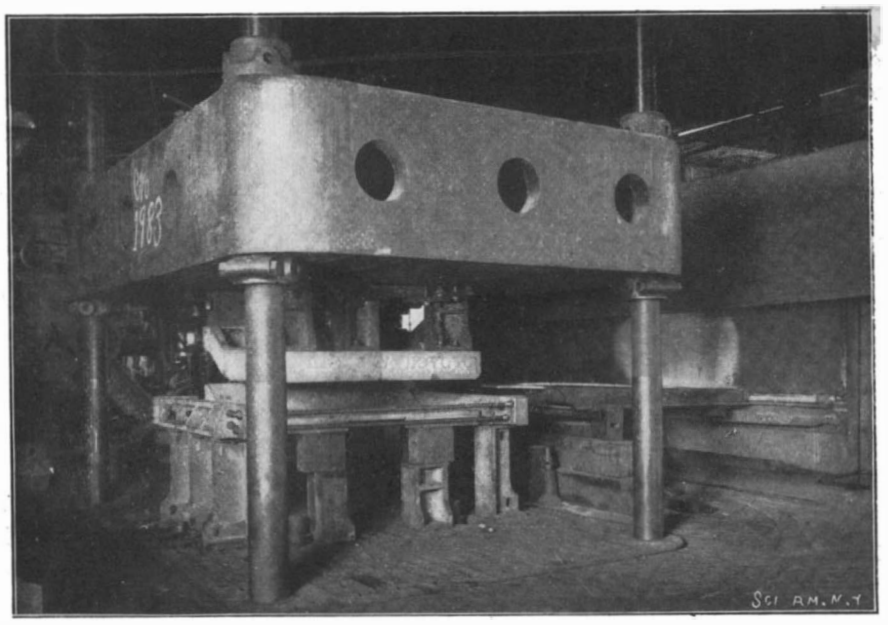
Front View of the 20,000th Baldwin Locomotive Showing Arrangement of the Four Cylinders and Two Piston Valves.



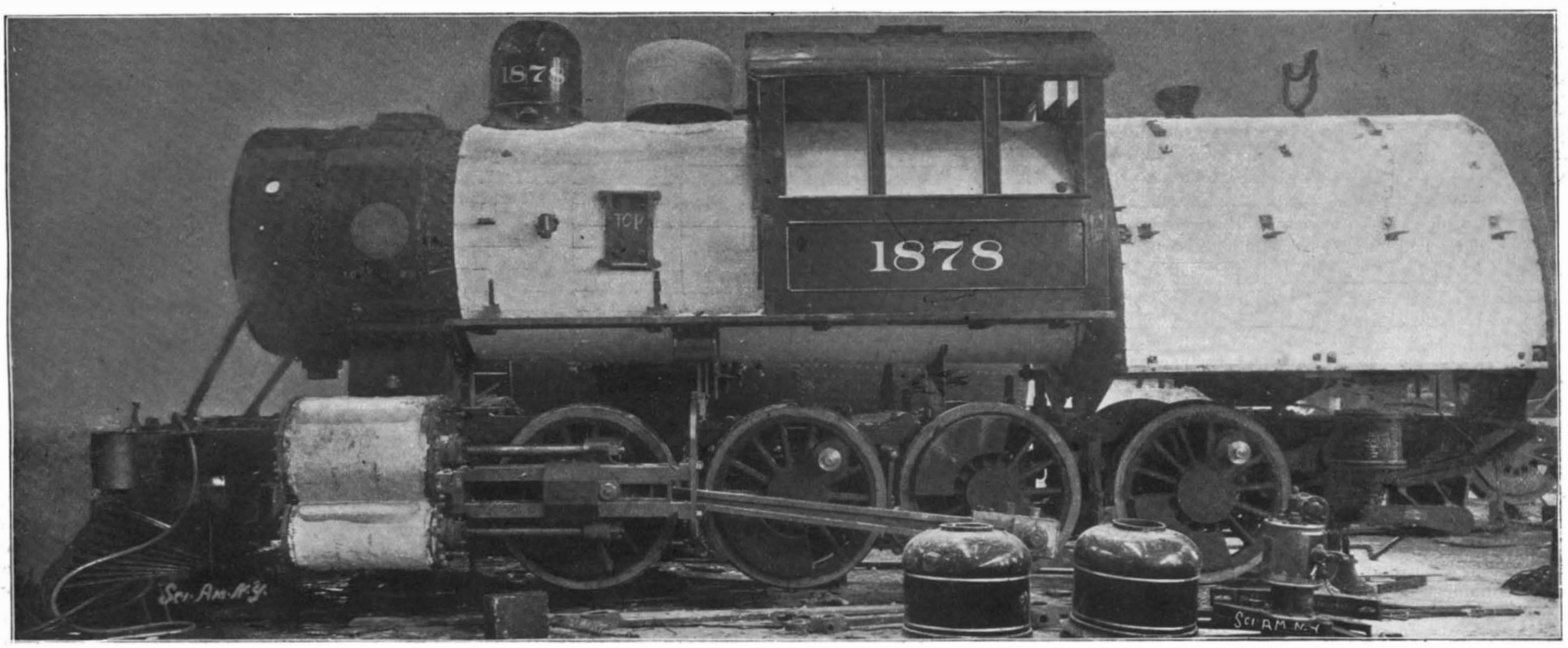
Planing the Bearings for the Frame Rails.



The Boiler Shop.



Hydraulic Press for Flanging Boiler Plates, Etc.



Fourth Stage of Locomotive Erection: the Boiler and Cylinders Lagged with Magnesia.

THE BUILDING OF AMERICAN LOCOMOTIVES—II.—[See page 121.]

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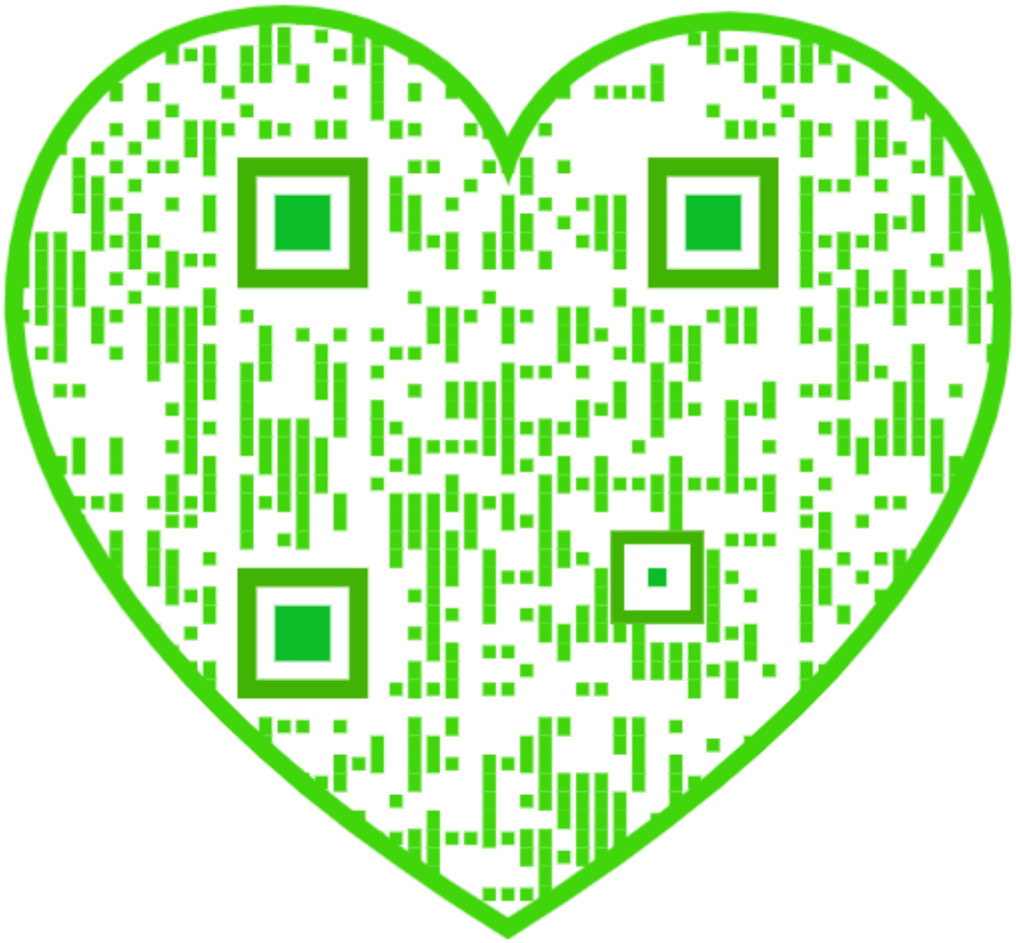

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NEW YORK, SATURDAY, AUGUST 23, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

DYNAMITE CRUISER FIASCO.

The announcement from Washington that the Secretary of the Navy is likely soon to order the dismantling of the once-famous dynamite cruiser "Vesuvius" will cause no surprise to students of naval matters who have kept in touch with the latest history of the much-vaunted "dynamite" gun. It was at a time when the pneumatic guns of Zalinsky for throwing gun-cotton in large quantities were at the very height of their premature reputation, that Congress, in spite of the recommendations of the naval experts to the contrary, ordered the construction of a fast cruiser which was to be armed entirely with pneumatic dynamite guns. At the same time large appropriations were made for the emplacement of batteries of the same type of gun at various commanding positions on the United States seaboard, such as Sandy Hook, the entrance to San Francisco harbor and the entrance to the Sound. If, as is likely, the dynamite guns of the "Vesuvius" and the costly, complicated apparatus for working them are removed from that vessel and sold for old junk, there will be a precedent for such action in the recent fate of the dynamite guns at Sandy Hook which, costing originally hundreds of thousands of dollars, were sold for the paltry sum of $20,000. Those who were responsible for the construction of the "Vesuvius," and who still have faith in the annihilating powers of the dynamite gun, cannot complain that their theories have not received every encouragement to demonstrate their practical value. The "Vesuvius" was sent to Santiago for the avowed purpose of blowing the Santiago forts into submission; but although she threw a few tons, more or less, of guncotton upon the Cuban coast, it has yet to be proved that any material damage was done to the Spanish fortifications. It is to be hoped that in the dismantling of this vessel, we shall hear the last of this ill-advised exploitation of a costly fad.

THE INSPECTION OF THE BROOKLYN BRIDGE.

It is gratifying to note that under the present administration the shameful neglect of the Brooklyn Bridge, which occurred under Tammany rule, has given place to a very thorough and systematic care of this, the most monumental engineering work in America. One immediate result of the appointment of a thoroughly qualified engineer as Commissioner of Bridges is, that the structure is now inspected and kept in repair with the same business-like methods that characterize the maintenance of a first-class railroad. In his recent report, Commissioner Lindenthal states that there is now a careful and systematic inspection of the bridge made each working day by a gang of men, acting under the supervision of the assistant engineer in charge, who keeps a daily record of what is done. A force of riggers, riveters, carpenters and painters is constantly employed in making repairs and general improvements. It will be remembered that some eighteen months ago, when several of the suspender rods broke at the middle of the span, the bridge came very near to experiencing a colossal disaster. The public will be glad to know that these rods and their connections (always a faulty feature in the construction of the bridge), are receiving special attention. Every suspender rod, and each stirrup rod of the wire-rope suspenders, is subjected to minute inspection. This involves the removal of the rods one at a time; and if there is the slightest sign of corrosion and rust, the rod is either repaired or replaced by new material. The hinged bearings of the short suspender rods are now kept oiled and thoroughly lubricated. Moreover, a number of tests have been made on full-sized rods which have been removed from the structure, and we are informed that, in every instance when the rods were tested to destruction, it was found that they developed from ten to twelve times greater strength than the maximum load which the rod would be required to sustain in the bridge. This result, by the way, fully bears out the conclusions reached by the SCIENTIFIC AMERICAN when we inspected the hinged bearings and broken rods at the time of their failure. We pointed out that these members were amply sufficient for their work, provided only that the hinged bearings were protected from rust and kept in a well-lubricated condition.

THE ARMSTRONG ORLING WIRELESS TELEGRAPH.

Some time ago we described in the SCIENTIFIC AMERICAN the wireless telegraphic and telephonic apparatus devised by Messrs. Armstrong and Orling of London. This invention has now been perfected sufficiently to be placed on the market, and two factories are being erected, one in Buckinghamshire, England, and the second in France.

Since our description was published one or two important improvements and alterations have been made. At that time, the inventors were experimenting with new receivers and transmitters of greater sensitiveness, since the ones they were using were only efficient for a distance of about 2 miles, but by continued investigations they have increased the efficiency to 20 miles.

When telegraphing over a greater distance the inventors intended, as described in our previous article, to place automatic relays at intervals of 20 miles which would receive and re-transmit the impulses with regenerated potential. Now, however, they have devised an alternative and apparently superior process, similar to that of Marconi, i. e., by high poles, from the upper extremities of which the electrical impulses are transmitted. The one advantage of the Armstrong-Orling system, however, is that the poles do not need to be so lofty, nor is it necessary to increase the height as the distance from station to station increases. This is due to the high efficiency of their capillary relay, the mechanism and principle of which we also fully explained. This relay has been submitted to comparative tests with the Siemens' relay, which is used by Marconi, and the results have been very startling in character. A Siemens' relay with a current of 8 volts was affected at a maximum distance of 1,600 miles; the Armstrong-Orling relay recorded electrical impulses of only 0.1 volt potential at a distance of 12,990 miles.

It will be recollected that Marconi failed to validate many of his inventions in the European countries. The reason for this has since been proved to be due to the fact that Armstrong and Orling were exploiting in the same field, and had protected their inventions before Marconi began his investigations. Nothing has been heard of the Armstrong-Orling invention until lately, owing to the fact that the inventors were sufficiently wealthy to pursue their investigations without seeking any extraneous financial assistance. Consequently they have not placed their apparatus upon the market until the invention has been sufficiently advanced and perfected to render it practicble and of commercial utility.

ELECTRIC TRACTION ON ENGLISH SUBURBAN ROADS.

Owing to the severe competition with which the English trunk railroads are threatened in their suburban traffic around the big cities by electric street railroads and deep level electric tubes, one or two of the big railroads are preparing plans for the electrification of their suburban tracks to meet the competition. The Lancashire and Yorkshire Railroad, which serves several busy cities, such as Liverpool and Manchester, have prepared elaborate plans for the conversion to electricity of many of their short tracks. The first experiment with this system is to be made upon a branch line running from Manchester to Liverpool through residental districts. The population is more dense in this area than in any other part of England except London. Between Liverpool and Southport there is already a fifteen minute service, and around Manchester some branches have trains nearly as often. With electric traction a four or five minute service or less would be inaugurated; and by having motors fitted to each car, the train could be made long or short according to the exigences of the traffic at different hours of the day. When the Mono Railroad between Liverpool and Manchester is completed, by which the journey of 36½ miles is to be accomplished in twenty minutes, the electrification of this section of the main track of the Lancashire and Yorkshire Railroad will probably be completed in order to meet the mono-rail competition. The journey with steam traction occupies at present forty minutes. The North Eastern Railroad, another large concern serving the busy portions of Northeast England, are going to convert to electricity at once a number of their branch tracks, commencing with the Newcastle to Tynemouth, the Gosforth to Ponteland, and the Quayside branches. The North Eastern will be the first great English railroad to adopt electric haulage, though the other trunk railroads are contemplating a similar conversion upon an elaborate scale. At the present moment there is a great movement in Great Britain toward the adoption of electric traction upon an extensive scale.

THE GREATEST OF BATTLESHIPS.

We wish to call particular attention to the magnificent United States battleship, of which we present an illustration elsewhere in this issue. It may be stated, we think without fear of contradiction, that the design which has been drawn up by the Navy Department of the "Connecticut" and "Louisiana" represents by considerable odds the most effective fighting craft, both for offence and defence, that exists anywhere in the world to-day, either afloat, on the building ways, or on paper. Seeing that the first duty of a battleship is to fight—to work the greatest possible amount of injury to the enemy in the shortest possible time—it is evident that in this respect the measure of the efficiency of the ship will be the weight, number, and disposition of her guns. From revolutionary times to the present day America has realized this cardinal fact, as proved by the number and weight of the guns with which her war vessels have always been armed. It was to their crushing superiority in gun fire that the American ships in the sea fights of the war of 1812 owed their brilliant and oft-repeated victories; and it is a gratifying fact that, when it came to the question of the creation of an entirely new navy, our naval constructors never lost sight of the advantage of carrying a more numerous and powerful armament than your opponent. Witness the tremendous battery of the "Oregon" and her sisters with their four 13-inch and eight 8-inch guns in the main battery; or note the eight 8-inch guns carried by the "Brooklyn," a main battery the like of which is not to be found in any other cruiser of her displacement in foreign navies. The same characteristic is seen in the "Kearsarge" and in the admirable designs of the "Alabama" and "Maine" classes.

Now the "Connecticut" and "Louisiana," which, with the great British battleships "Edward VII.," "Commonwealth," and "Dominion," are the five largest warships in the world, mounts a battery which is so heavy as to place these vessels practically in a class by themselves. Each carries four 12-inch, eight 8-inch, twelve 7-inch and twenty 3-inch guns. The next most powerfully armed vessel is probably the "King Edward VII." She also carries four 12-inch, but instead of the eight 8-inch she is armed with four 9.2-inch guns. This, of course, is a much more powerful weapon than the 8-inch gun, but the rapidity of fire from the eight 8-inch, that is to say, the number of shots delivered in a certain time, will be so much greater that there will be far more likelihood of getting in an effective blow. It is the broadside battery of twelve 7-inch guns, however, that renders the "Connecticut" so much more powerful than the "King Edward VII.," which carries only ten 6-inch against the greater number of 7-inch. An increase of an inch in caliber, when you get to the size of a 6-inch, means a great increase in power. Furthermore, the "Connecticut" will carry twenty of the 3-inch guns, as against ten or twelve of the same caliber carried by the latest British battleship. The "King Edward VII." will have about the same amount of armor protection as the "Connecticut" and half a knot greater speed. Outside of the latest British design there is no foreign war vessel that can compare in size, battery and protective qualities with our latest designs. The "Connecticut" is to be constructed at the government navy yard, Brooklyn, a fact which is a guarantee that the workmanship will be of the very highest quality throughout.

FESSENDEN WIRELESS TELEGRAPH PATENTS ALLOWED.

The last issue of the Patent Office Gazette contains thirteen patents on wireless telegraphy apparatus which have been granted to R. H. Fessenden, who is an expert of the Weather Bureau at Washington. Among the patents are included a device for signalling by magnetic waves, a current-actuated wave-responsive device, and also a conductor for wireless telegraphy apparatus. This is the apparatus to which reference was made recently in the SCIENTIFIC AMERICAN as having been employed by Mr. Fessenden in competitive tests of the wireless system which were made on the Carolina coast some little time ago. It was stated at the time that the results secured by Mr. Fessenden's device were superior to those of any other systems included in the tests.

The tallest steel chimney in the city of New York was recently torn down. The stack, which was 18 feet in circumference, consisted of thirty sections, each weighing a ton. In taking down the chimney, the workmen rigged up a scaffold about 10 feet from the top. Perched upon this support they punched out the rivets that held the adjacent sections together, and lowered the two sections, weighing two tons, by ropes connected with windlasses. The scaffold was then lowered to the next two sections, where the disjointing work was continued. The removal of the chimney was effected at a cost of about $2,000.

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THE PASSING OF AMERICAN PLAGUES.

BY GEORGE ETHELBERT WALSH.

Ancient Egypt in all her tribulations had no more disastrous plagues of flies or lice than were the great insect scourges which visited different sections of the United States in the past, and the gradual passing of these plagues before the work of science marks a new era in our agricultural and industrial life. The story of the terrible scourges form dramatic and picturesque background for the history of the great West, and they are intimately wrapped up and interwoven with the struggles and discouraging hardships of a race of pioneers who lived their tragic lives to conquer an empire for future generations to enjoy. Counties and States equal to half of continental Europe were visited by the plagues of locusts, chinch bugs and grasshoppers, and their entire vegetation laid as bare and waste as if swept by fire.

Some recent statistics have been compiled by the Washington agricultural experts which tend to show that back in 1867 the total annual loss to the farm crops of this country from insect ravages amounted in round numbers from $200,000,000 to $300,000,000. One well-informed expert places the losses even higher, or about $330,000,000. These losses were sustained in different parts of the country, and included insects which attacked the grain, corn, fruits and animals of the farming States. Some years the breaking loose of hordes of well-known insects of grain or fruits would totally destroy the crops and cause such general distress and poverty that starvation seemed to threaten the inhabitants of entire counties and States.

The great locust plagues were among the earliest of the West and Northwest, and those who remember these terrible visitations will never forget the conditions under which farmers were forced to live for months at a time. Men became frightened and paralyzed with fear; prayers were offered up in churches and public places to remove the awful plague, and even executive proclamations were issued by the Governors of the afflicted States calling for general supplication for divine aid in removing the visitation. In 1877 the Governor of Minnesota issued such a proclamation, appointing the 26th day of April as a day for prayer throughout the State for this purpose. In 1873 considerable damage was done to the grass and grain crops by the locusts which appeared in southwestern Minnesota, and by the following season they had spread so that they caused general alarm. Millions of the creatures appeared, and they swept across the country destroying every green thing in their way. So great was the destruction to the crops that an appeal was made to the Legislature the following winter, but nothing was done to check the scourge, and in 1875 the swarms had multiplied tenfold.

During that summer, and the two succeeding ones, the scourge spread with alarming rapidity throughout the State, and into adjoining States, until there was such a succession of crop destructions that the inhabitants were reduced to starvation. Efforts were made then to destroy the plague and to invent some means of checking its further spread. Coal oil was distributed throughout the infected districts to destroy the insects, but this primitive and clumsy method seemed to have little sensible effect in diminishing their numbers.

Farmers and their families spent their summers in destroying locusts. In the Dakotas and Iowa their numbers became so great that people were in despair. It was impossible to raise crops. If they were raised the swarms of locusts would destroy them before they could reach maturity. By the spring of 1875 and 1876 the great Northwest had nearly reached the limit of patience. Bankruptcy stared the whole northwestern group of States in the face. In the autumn of 1876 the Governors of Minnesota, Missouri, Kansas, Nebraska, Dakota and Iowa met at Omaha to discuss the plague and devise some means of averting the ruin that was paralyzing their fertile land. Eminent entomologists met with the Governors in this conference, but all that science could suggest had been tried, and the conference broke up without anything more definite being reached than the calling of a general day of prayer.

A strange coincidence, or, as some will have it, a divine answer to the public prayers, followed the 26th day of April set aside for this purpose. A few warm days brought the locusts from their winter hiding places in great numbers, and then a cold wave suddenly developed in the Northwest, and the unhatched larvæ and young locusts were almost totally destroyed by the frost which spread over the whole afflicted sections.

It was estimated that billions and billions of eggs of the locusts and their young larvæ were destroyed by this cold wave, coming, as it did, right after a few days of balmy spring weather. It was the only thing that saved the Northwest from bankruptcy and from a period of depression that would have lasted to this day. The millions of dollars lost through crop destruction had caused many to emigrate from their homes, leaving their farms in many instances just as they were, and fleeing from the plague as did the ancient Egyptians. The awful screech and noise made by the locusts maddened and crazed men, women and children, and the days became horrible nightmares which have never since been equalled.

The locust plague passed years ago, and for twenty-five years there have been only occasional reminders of it in visitations of the insects in a few isolated sections. There has been no general spread of it as in 1873-76. Under modern methods of checking insect development it would be impossible for the locusts ever again to multiply in such vast numbers. There are great locust plagues occasionally in South Africa and South America, and they spread as thickly over the country as they did in the Northwest a quarter of a century ago; but it is not likely that another such visitation will ever appear in this country.

Another great plague, which visited the West fifteen and twenty years ago, and which occasionally develops into huge proportions to-day, is that caused by the chinch bug, which has until quite recently been called the "costliest insect in America." This famous bug has caused a hundred million dollars' worth of damage to crops in a single year. As far back as 1850 the bugs appeared in such numbers that the grain crops of a single State, Illinois, were damaged to the extent of four million dollars. It had appeared previous to this in Indiana and Wisconsin, causing considerable injury to the crops. Periodically it appeared then in great numbers in widely separated regions. In 1863 to 1865 it caused great damage, but in 1871 it caused a total loss of over $70,000,000 to the farmers. But even this was merely a slight indication of what it might do in time. In 1874 it broke loose in Iowa, Missouri, Illinois, Kansas, Nebraska, Wisconsin and Indiana, and caused total losses of about $100,000,000. After that season the ravages decreased a little, but reached another great climax in 1887, when the bugs caused fully $60,000,000 worth of injury to the grain crops. As late as 1896 a chinch bug plague appeared in the West, and caused considerable damage. Altogether the successive plagues of this tiny insect have caused losses to the farmers of the country amounting to over $330,000,000. Such an immense total is sufficient to make this insect occupy a prominent place in the natural history of the great Northwest. No other insect of either hemisphere has probably caused quite such immense damage, although the Rocky Mountain locust or Western grasshopper stands prominently among the most disastrous of our insects. In 1874 the losses incurred by the ravages of the locust were estimated at $100,000,000.

The chinch bug, unlike the grasshopper or locust, has not yet lost its power for evil, and its reappearance in great numbers may be looked for almost any year; but it would be met by far more destructive agencies than in the past, and all the resources of science would be enlisted in the fight against it.

The chinch bug is a pretty small insect to cause so much trouble, and it is hardly discernible to the naked eye, but each female lays about 500 eggs in a season, and the newly hatched insects are very active. The favorite diet of the insects is grain, grass, sorghum, broom corn and Indian corn. Most of the damage has been done in the West to such crops as wheat, barley, rye and corn. The insect has remarkable immunity from attacks by ordinary enemies, a disagreeable odor emanating from it which protects it from many predatory insects which would otherwise keep down its numbers. There are a few natural enemies to the chinch bug, and entomologists have made a study of different insects and diseases which tend to destroy the creature. Efforts have been made to spread parasitic diseases among the chinch bugs to destroy them. The effectiveness of these different methods is not entirely satisfactory, and science is still laboring to find some means of counteracting another plague of chinch bugs should it break out in the great grain growing regions of the West. There is at present no absolute assurance that another chinch bug plague may not visit this country in the near future. The chief guard against any such dire visitation is found in the close watch kept upon the insects in different parts of the country. As soon as there is a slight outbreak in one section of the West, attention is called to that region, and every effort is made to destroy the eggs and larvæ of the insects before they have had the opportunity to multiply in great numbers. The passing of all these plagues is due chiefly to this eternal watchfulness kept upon the creatures and to the immediate steps taken to destroy the eggs and larvæ at an early stage. In this way no great swarms are ever permitted to get the ascendency.

In the South the greatest insect plagues have been those which attacked the staple farm crop of that section. Cotton's worst enemy has been the cotton caterpillar or cotton worm, and the boll worm. The former caused annual losses to the cotton industry in the South of some $15,000,000, and twice in the memory of man the damage amounted to over $30,000,000 in a single season. The cotton caterpillar has always been with the planters in the South, and periodic visitations occur.

ROBERT BACH M'MASTER.

It is with sincere regret that we record the death in this city on the 13th instant of Mr. Robert Bach McMaster. For several years, and up to the time of his decease, he was connected with the Patent Department of the SCIENTIFIC AMERICAN as an associate attorney in conducting the business pertaining to interference proceedings before the Patent Office, as well as other law matters connected with trade-marks and copyrights. In this work he early gained the reputation of a careful, painstaking, industrious and honest lawyer, winning the esteem and friendship of all who became acquainted with him.

Mr. McMaster was born in Brooklyn, N. Y., in 1847 and was the grandson of Robert Bach, well known in that borough in the early years of the last century. His education was received in the public schools of this city and in the College of the City of New York, from which he graduated with honors in 1868.

After studying law in Columbia Law School and being admitted to the bar he turned his attention to the further study of law relating to railroad corporations, and in 1872 "McMaster's New York Railroad Laws," prepared and compiled most carefully, was published and was highly regarded as a work of superior value. He also published notes on "The Business Corporation Act of 1875."

Subsequently he made patent law his specialty and rose steadily to an honorable place at the patent bar.

One of the most noted cases as associate attorney with Mr. William McAdoo, that Mr. McMaster carried to a successful issue, was the Rahtjen Paint Composition Trade-mark case, which was appealed to the United States Supreme Court.

The case established the doctrine that where a trade-mark applied in the United States to an article patented in England, but not in the United States, the trade-mark became public in the United States when the English patent expired.

His ability as an attorney, his sterling integrity, open-handedness and sweetness of character won for him a lasting place in the affections of a host of friends.

There survive him a brother, Prof. John McMaster, of the University of Pennsylvania, author of "McMaster's History of the People of the United States," and a sister, Mrs. Mary McMaster Metcalf.

In Washington, where he was frequently called to conduct important cases, he enjoyed the esteem and confidence of his many acquaintances in the Patent Office, displaying unusual ability in the management of evidence for the best interests of his clients and employers. He discharged every trust with zeal and ability.

His presence will be greatly missed, but the memory of his whole-souled, honest, unselfish character will be cherished most by those who knew him best.

SCIENCE NOTES.

The South Kensington Museum, London, has been presented with the famous Walsingham collection of micro-lepidoptera, consisting of 200,000 specimens, and upon the collection of which Lord Walsingham has been engaged for thirty years. The Walsingham collection is the largest and the most important in existence. It includes among others the famous Zeller collection, and also those formed by Hofmann and Christoph. The specimens embrace many of the originals selected as standard types by various authorities who have written on the subject.

The time-honored rule that moss grows on the north side of a tree, a rule which forms part of every woodsman's catechism, and which he would no more dispute than one of the Ten Commandments, has received a few sharp blows from Henry Kraemer, of Philadelphia. An investigation which he has conducted shows that on 10 per cent of the trees which he examined moss grew on the west side; 10 per cent on the northwest side; 20 per cent on the northeast side; 35 per cent on the east side; and 15 per cent on the southeast side. What becomes of the old rule after such iconoclastic investigation?

Four years ago the Belgian Government offered a reward of $10,000 for the discovery of a paste for matches, not containing white phosphorous, in order to mitigate the evil influences which the present manufacture of matches exercise upon the employees. The arbitrators, however, although they have tested several so-called harmless mixtures, have not yet discovered one that fulfills the required conditions, since all the mixtures so far submitted have been defective in inflammability, igniting on all surfaces, or, in igniting, ejecting inflammable matter containing poisonous substances. The matter is of supreme importance to Belgium because match making is one of the staple industries of the country, but the mortality in the manufactories is very high, the prevalent complaint being phosphorus poisoning.

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SOME RECENT ARCHÆOLOGICAL DISCOVERIES IN MEXICO CITY.

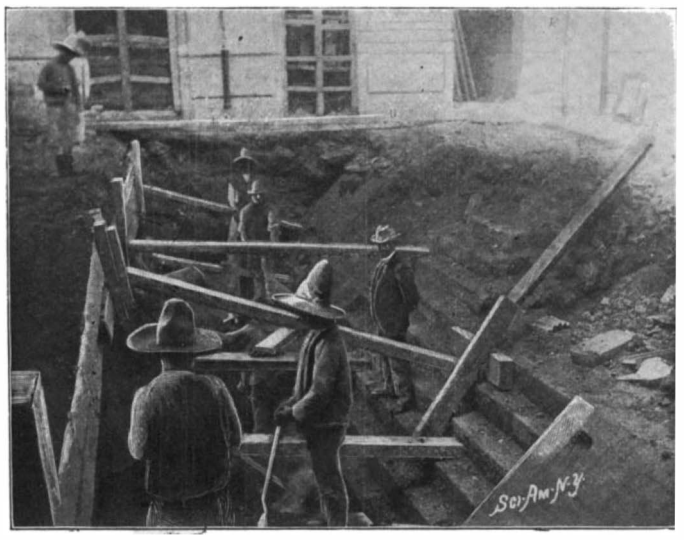
BY THOMAS R. DAWLEY, JR.

The unearthing of the remains of an Aztec temple in the city of Mexico last winter promises to shed much additional light upon the ancient capital of the Aztecs. The discovery was made in the heart of the city, only two squares east of the great plaza, or Zocolo, and constitutes one of the most important archæological discoveries made in years. In addition to the temple, several huge monoliths, stone idols, incense gum, spear heads and other interesting objects were brought to light.

Some years ago the eminent archæologist Señor Batres, of Mexico, projected a map of the city of Tenochtitlan as it existed in the year 1519, when first seen by the Spaniards. This map represented the city as an island intersected with canals running nearly at right angles, corresponding to the streets of the present city. He located on the map the various temples and public edifices of the Aztecs, all of which, of course, had been destroyed by the conquerors. Back of the great temple, or Teocalli, which occupied the present site of the cathedral and major portion of the plaza, he located a temple called Coateocalli, meaning the house of many gods. He gave as his authority for locating this temple, Padre Duran, who wrote that the temple existed on the site occupied by the property of the Acevedos. Searching the archives, Batres found among the records in reference to an ordinance regarding the supply of water, under date of October 27, 1710, that the property referred to was on the corner of Relox and Cordobanes streets, and consequently gave that as the locality of the temple of many gods, but as the corner was occupied by a fine old building, it was not supposed for a moment that any remains of the ancient temple could possibly be in existence.

Last winter the work of renovating, or practically rebuilding the old palace occupying this corner was undertaken, for the purpose of furnishing suitable quarters for the Department of Justice. Captain Diaz, the son of President Diaz, was given charge of the work, and it is due chiefly to him that the discoveries were made. While the workmen were leveling off the patio, or central courtyard of the edifice, previous to putting down a new pavement, they came in contact with a hard solid foundation which proved to be a flight of stone steps going down into the earth. They would probably have covered them up again, and leveled off the projecting one at the desired height, had not young Diaz happened along just in time.

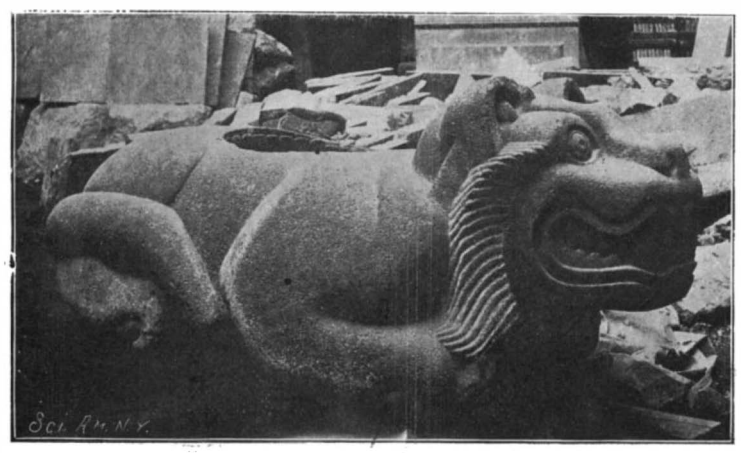
Diaz ordered the men to keep on digging, cautioning them to use their tools carefully, and following a line parallel with the steps, a trench was opened the entire length of the patio. At the further end of the trench, scarcely two feet below the surface the men struck what appeared to be a round, polished rock, around which they carefully worked, pulling the dirt out with their hands, till they had disclosed a monolith weighing several tons, representing a tiger recumbent, or ocelotl, ready to spring. A rude derrick was rigged up, the sculptured rock hoisted out of the hole and it was weighed and measured.



EXCAVATING THE TEMPLE.

Further excavating brought to light another rock sculptured to represent a serpent's head, which corresponds with two others previously discovered, and which were the corner pieces of the great wall inclosing the great Teocalli, within which are said to have dwelt seven thousand Aztec priests. Besides the great pyramid rising in the center, upon which they made their human sacrifices to the war god, there were seventy-eight chapels devoted to the worship of special deities. After the two huge monoliths were removed from the excavation, the digging proceeded, and the dirt carefully removed, every object found was cleaned and put aside for the inspection and study of Señor Batres. The foot of the steps was finally reached at a depth of thirteen feet below the level of the present city of Mexico, where they rested on a solid base, or foundation of masonry, which was without question the level of the old city of Tenochtitlan; consequently the present city of Mexico must be some 13 feet above the level of the original city, which presents an interesting problem to the archæologist.

At the foot of the steps many of the smaller objects were found, such as idols, remains of idols, incense gum, spear heads and ornaments, just as they had been thrown down by the Spanish conquerors. The stumps of two trees growing at the foot of the temple were also uncovered. These trees had evidently taken root after the destruction of the temple. They were found at irregular distances from the steps, and had the appearance of having grown spontaneously, just as the trees are growing at the present day out of the ruined walls of Palenque, and other aboriginal cities.



THE TIGER, OR OCELOTL.

The recumbent tiger or ocelotl, weighs four tons. It measures 2 meters, 30 centimeters long, 1 meter 5 centimeters wide, and 94 centimeters in height. Its mouth is open, showing huge teeth and a part of its tongue, and great round eyes give it a ferocious look. It is well modeled, with the tail properly curved around on one side as the animal is often seen in life. On each side of the head is a mane resembling somewhat the pendant part of the head-dress on the Egyptian Sphinx. On its under side are vestiges of painting showing that it was originally painted with red and yellow to carry out more perfectly the idea, or imitation of the American tiger. Cut in its back is a cylindrical cavity about eighteen inches in diameter and five in depth. The sides and bottom of this cavity are sculptured with representations of Aztec figures, or warriors.

The serpent's head, identical with the other two already discovered, represents the serpent with its mouth open and the upper lip rolled up over its forehead, disclosing the upper jaw with great tusks projecting down over the under lip. It is supposed that there were four of these heads, one in each corner of the great wall, and the design corresponds to similar heads graven on the Aztec Calendar stone. On the under surface of the heads, Batres has deciphered a hieroglyphic which he calls *tres acatl*, the date of the foundation of the Great Teocalli.

Among the other relics unearthed was a curious little idol cut out of a dark porous stone, about 10 inches in height. The workmanship is rather crude, but decidedly interesting, representing a head with scarcely any body, perhaps in a sitting posture with arms folded. The incense gum upon being removed from the earth which had surrounded it for centuries resembled pieces of bone, but when, by the simple application of a lighted match, it burned and gave off the proper perfume, it was proved to be incense.

A number of stones were fashioned in the shape of skulls, or death heads, with projections at the back as though they had been inserted into a wall. Some of them were painted white, which gave them a more horrible aspect. A very interesting relic was a piece of baked clay, a part of a foot of a colossal statute. The toes were perfectly modeled, showing the edge of the leather sandal beneath, and the knots of the thongs holding it over the instep as worn at the present day by the native Indians. Other smaller pieces of this same statue were found, and in handling them one could imagine the great war chief in full regalia guarding the portals of the temple when set upon by the Spaniards and hurled down the steps to the bottom.

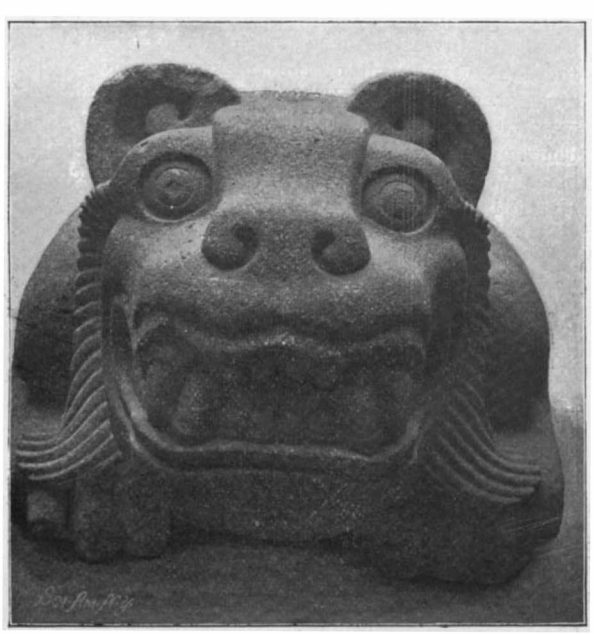
All the objects found are to be preserved in the National Museum, and it is proposed by Captain Diaz to leave the patio with the excavation open, showing the remains of the temple. The very interesting question now arises, how is it that the present city is 13 feet above the old one, as shown by the excavation.

We know that when Cortez first saw the Aztec city, he compared it to Venice on account of its being composed of islands, and having canals for its streets. With the destruction of the city, the temples and public edifices were toppled over, filling up the canals. It would seem that the Spaniards would have taken this material to build their new city, but it is evident that they did not. In building the new city they brought building material from elsewhere and built on top of the old.

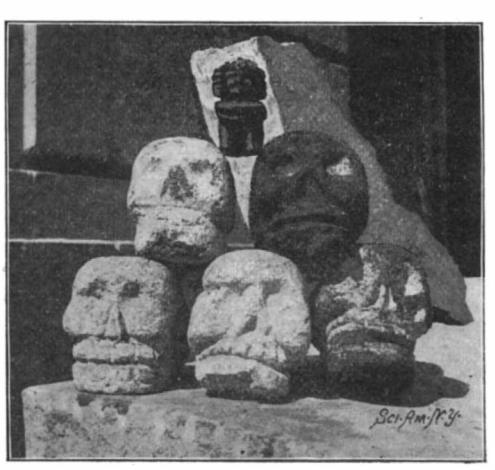
SMALL STONE IDOL.

Another fact demonstrated by the discovery of the temple is that the reconstruction of the city began in a very feeble manner, for the stumps of trees growing at the base of the steps show that the ruins of the temple must have remained just as the Spaniards destroyed it a long time, thus giving the two trees ample time to sprout between the crevices and grow before they were eventually buried by the debris, upon which the palace of the Acevedos was built, more than a century, or a century and a half later.

The great cathedral was not commenced till a century after the destruction of the city by Cortez, and like the palace of the Acevedos, it must have been built upon the ruins of the Great Teocalli. We can therefore conceive Tenochtitlan a ruined city for upward of a century, with its demoralized remnants of a once proud race wandering about the ruins till finally the site was accepted for the Capital and the



HEAD OF OCELOTL.



STONE SKULLS WITH SMALL IDOL ON THE TOP.

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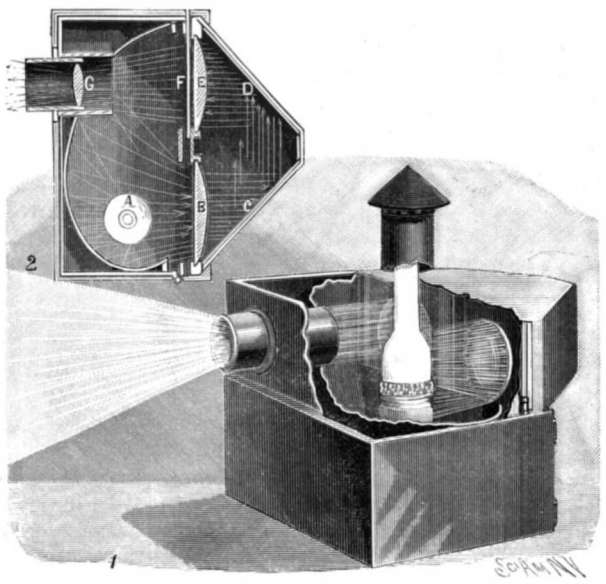
reconstruction commenced in earnest. The value and quantity of relics which are buried beneath these structures can only be conjectured.

IMPROVED PICTURE PROJECTING APPARATUS.

Heretofore magic lanterns have been devised either for projecting transparent pictures only, or for projecting opaque pictures only. Some transparency projectors, however, have been provided with an attachment whereby the same may be converted into a projector for opaque pictures. While this is suitable for certain classes of exhibition it nevertheless falls short of the requirements when it is desired to exhibit transparent and opaque pictures interchangeably; for considerable time is consumed, and trouble involved, in making proper adjustments necessary to effect the change from one class of picture to the other. Moreover, certain specially interesting pictures or objects—viz., those partly transparent and partly opaque—cannot be projected by such lanterns. With these conditions in mind Mr. George W. Smith, of Evanston, Ill., has recently produced and patented an apparatus which will project any class of picture or object without requiring any special adjustment. The invention is applicable to any kind of magic lantern, but more particularly to the form commonly known as the megascope.



IMPROVED PICTURE PROJECTING APPARATUS.

As shown in our illustration, the invention comprises a lantern box, at the rear of which is hinged a reflection chamber having vertical walls arranged obliquely with respect to the front wall of the box. A light, *A*, for example a Welsbach light, is located at one side of the lantern box at one focus of an ellipsoidal reflector, the picture or object to be projected being inserted at the other focus. On the opposite side an opening is formed in the reflector for the admission of the objective tube. Rays from light, *A*, pass through a condensing lens, *B*, to one of the oblique walls of the reflector chamber. Reflectors, *C* and *D*, are provided on these walls and they act to reflect the rays back through a condensing lens, *E*. A transparent lantern slide, *F*, when placed before the lens, *E*, intercepts the rays and permits the proper gradations of light and shadow to be projected by lens, *G*. onto the screen. Such is the effect when a transparent slide is used. When an opaque slide is to be projected, the direct rays from lamp, *A*, and also the indirect rays concentrated by the ellipsoidal reflector, illuminate the front of the slide, and the proper image is thus reflected through lens, *G*, to the screen. If the slide be partly opaque and partly transparent or translucent, the lantern will operate simultaneously as a megascope and sciopticon combined, thus, without any change, producing unique effects in a very simple, inexpensive and yet satisfactory manner.

The lantern should be very useful for scientific purposes for the reason that the same object may be projected by reflected light alone or by transmitted light alone, or by both simultaneously without removing the slide or changing the adjustment of the projector.

MOVING LARGE TREES.

An Iowa inventor has devised a very effective machine for lifting and moving heavy and cumbersome objects. The machine, which we illustrate herewith, though primarily designed for lifting rocks and bowlders, has nevertheless been found equally useful for raising and transplanting large trees. A description of this tree-lifter should prove of great interest to landscape gardeners, for it provides them with an easy and comparatively inexpensive means for transplanting and setting out large trees without injuring them. Our engraving shows the machine handling a tree 1 foot in diameter and 30 feet long. This, however, does not illustrate the full capacity of the lifter, for it has easily transplanted trees as large as 20 inches in diameter. The frame of the machine is V-shaped, the rear wheels of which support the outer ends of the frame while the apex rests on the front truck. Thus it is possible to back the machine up to the tree which it is desired to move so that the two arms of the frame will straddle the trunk. When the machine has been backed sufficiently to bring the hoisting drum into contact with the trunk, the front truck is swung around at right angles to the rear wheels so as to give a firm anchorage for the machine when the hoisting mechanism is operated. The horses are now detached from the machine and are hitched to the hoisting gear. A connecting rod is fastened across the rear extremities of the V-shaped frame, and serves the double purpose of increasing the rigidity of the machine and of supporting the trunk when the tree is drawn out of the ground. A padded roller on this connection serves to prevent injury to the trunk. A bar-chain is now placed around the roots of the tree, which have been previously cut loose from the surrounding earth. This chain is attached to the lifting-drum and the tree is slowly drawn up until the roots clear the ground. At the same time the trunk gradually sinks back until it is supported by the padded roller. The power for thus raising the tree is supplied by the team, which, as stated above, is hitched to the hoisting mechanism. The tree is locked in this position by a ratchet wheel and is now ready for transportation.

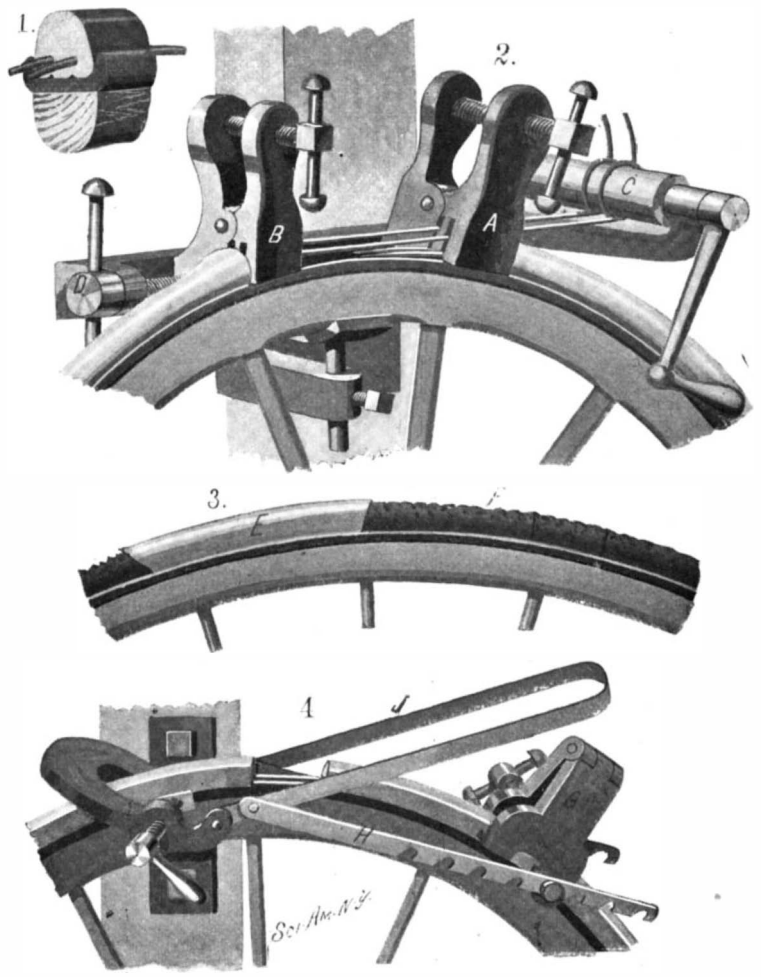
POWERFUL MACHINE FOR MOVING LARGE TREES.

It is evident, of course, that a large hole has been left in the place which the roots of the tree occupied, a hole probably larger than can be safely straddled by the rear wheels. It is interesting, therefore, to note the novel method by which the machine is moved away from this cavity without its wheels sinking therein. Instead of being pulled directly forward the front wheels of the machine are first circled around the hole on the outer rear wheel as a center, until the machine occupies a position approximately at right angles to its original position, when, the hole having been cleared, the tree can be transported to any desirable locality. It is evident that by this method any hole can safely be avoided whose diameter does not exceed the distance between either of the rear wheels and the inner wheel of the front truck when turned at right angles. With the machine shown a hole of 14 feet diameter may thus be circled. When replanting a tree the same method must be pursued to avoid the cavity into which the roots are to be planted. When the hole has been sufficiently circled to bring the roots directly over the center, the tree is slowly lowered under control of a friction brake. In our illustration the operator of the machine may be seen grasping the lever of this friction brake. As soon as the roots have been lowered into the cavity, the machine is drawn forward, thus gradually raising the tree into an upright position. Guy ropes are then fastened to secure the tree in place, after which the rear connection is swung open and the machine is drawn off.

The frame of this tree-lifter is very strongly constructed of Washington fir, white oak and hickory with very heavy iron bracings. It has a direct lifting capacity of over 50,000 pounds, and it will, therefore, readily be seen that the machine would prove serviceable for moving heavy objects of all descriptions.

SOLID RUBBER TIRE SETTING MACHINE.

Solid rubber tires are ordinarily secured to carriage wheels by a steel tape or a pair of wires which run longitudinally through the tire, near its under surface. At present the wires seem to meet with more favor than the steel tape, and the reason for this lies probably in the fact that the tape first used was not heavy enough for the purpose, and soon broke or rusted away. Heavier tape is now used with better results; but a prejudice once formed is hard to overcome and wired tires still hold the lead. Aside from this prejudice there may be some good reasons for the preference of wire over steel tape. To admit the tape, the tire must have an opening which is much longer, in cross-section, than the sum of the diameters of the two wire openings. The tire is thus greatly weakened, and the more so when we consider the fact that the tape offers more of a cutting edge, even though its edges be rounded, because the diameter of the wires is greater than the thickness of the tape.



SOLID RUBBER TIRE SETTING MACHINE.

In Fig. 1 we show a section of a wheel rim with a wire-strung tire in place. The channel rim, which is secured to the felloes of the wheel, has a flange along each side, between which the tire is set and held by the two wires. The manner of stretching these wires and splicing their ends together, so as to form endless rings, is very interesting. A number of different machines have been designed for this purpose, among the simplest of which is the mechanism here illustrated. In Fig. 2 we have the machine for setting and splicing the wires together, after which the rubber must be straightened out and set by the device shown in Fig. 4. Both mechanisms are very compact and take up almost no room, because they can be fastened to the side of the wall, or against a post or column of the repair shop.

The wire-setting device consists of two clamps, one clamp, *A*, being stationary. The other clamp, *B*, is movable, being mounted on the tightening screw, *D*, by which it can be made to travel along the tracks on the main frame. A bracket projects out from the frame a short distance below the two clamps, and on this the wheel is hung, the felloe resting in an adjustable support which is raised sufficiently to bring

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the rim of the wheel against the bottom of the clamps. Clamp *B* is first drawn away from clamp *A*, to its extreme position, and then the tire, which has been previously strung with a pair of wires, is loosely fitted into the channel rim, its two ends being held back by the clamps, but the wires projecting through their jaws.

The wire ends which project through the clamp, *A*, are gripped by its jaws, but the other ends projecting between the jaws of clamp *B* pass freely through clamp *A*, and are wound around the drum, *C*. A block is placed in each clamp between the wires to hold them in their proper positions. The block in clamp *A*, however, is thinned down at its upper end so that the wires which extend to the drum, *C*, will not be gripped when the jaws are closed. These wires are now wound up tightly on the drum, *C*, and secured by closing the jaws, *B*. To attain the necessary tension the tightening screw, *D*, is operated. A powerful pressure is thus brought to bear on clamp *B*, which stretches the wires to their utmost. This done, all superfluous wire is cut away, and the overlapping ends filed on a taper to make a smooth joint. Asbestos is then packed under the wires, and particularly against the clamps, so as to prevent the intense heat, necessary in brazing, from harming the rubber tire. The wires are now brazed together in the usual way, and our first and most important operation is completed.

The wire rings, it will be found, have been drawn so tight that the rubber cannot, with ordinary means, be drawn over the splice, and this brings us to the second operation, which is illustrated in Fig. 4. The wheel is supported by a vise, which grips the rim near one end of the rubber tire, and a clamp, *G*, is secured to the other end. A U-shaped lever, *J*, straddles the wheel rim and is hinged to the vise. Pivoted to each leg of the lever, *J*, near the vise, is a ratchet bar, *H*, which has notches along its lower edge. These ratchet bars are adapted to hook over pins on each side of the clamp, *G*. Now, by drawing back the lever, *J*, the end of the tire which is held by the clamp is drawn, little by little, up against the end secured in the vise. Any unevenness or bunching of the tire is then in a similar manner straightened out, after which the wheel is ready for service.

The process for tape-strung tires is the same except, of course, that no separating block is necessary in the clamps, *A* and *B*. Inserting the tape into the tires is, however, rather difficult, because the tape is sure to bind along its edges. It has been found necessary to attach a force pump at one end of the tire opening, which is operated while the tape is inserted from the other end. The air pressure inflates the opening and permits a freer passage for the tape.

Car tracks, and particularly their switches, cause most of the damage to carriage tires. A terrible wrenching strain is received when the vehicle is suddenly swung out of a car track. Sometimes the rubber is so badly torn that it is necessary to patch it with a section of new tire. This is easily done, as shown in Fig. 3, the new section, *E*, being inserted in the old tire, *F*, and all made secure by the retaining wires.

ELECTRICAL RESONANCE AND ITS RELATION TO SYNTONIC WIRELESS TELEGRAPHY—I.

BY A. FREDERICK COLLINS.

The recent transference of the Pupin electrical resonance patents to the Marconi Company has created more than a passing interest in the application of resonance principles to syntonic wireless telegraphy.

In wireless telegraphy practice it is well known that an electric circuit having definite values of inductance, capacity and resistance will respond to currents of high frequency set up in a circuit of the same dimensions.

This phenomenon is termed *electrical resonance*, taking its name from the similarity of the action produced and the means by which it is accomplished to the resonance in acoustics where the sound waves cause a sympathetic vibration in a suitable medium. As a familiar illustration of acoustic resonance, let two tuning forks of the same size, pitch and form be placed a given distance apart so that the waves set in motion by the vibrations of the first fork will impinge on the second, when a vibratory reaction will take place and it will then respond to the fundamental tone and a second train of waves will be emitted.

The co-efficients of an electric circuit are its inductance, its electro-static capacity and its resistance, and upon these three factors the size of the circuit depends. Inductance is the effect of a current flowing in a straight conductor or a coiled wire on itself; the inductance of a wire is virtually electric inertia, since a current does not start or stop instantly, but requires the element of time to do either. Capacity is the quantity of electricity which must be impressed upon a circuit in order to increase its potential, or raise its pressure to a given value. The capacity of an electric circuit may be compared to that of a gas tank, the quantity of gas the tank may contain depends on the pressure with which the gas is forced in as well as on the size of the vessel; likewise the higher the electromotive force or pressure of the current and the smaller the capacity of the circuit, the smaller the quantity of electricity required to charge it to a given potential. The resistance of the conductor is the reciprocal of the electrical conductivity, or the ratio between the electromotive force of a circuit and the current it carries forward. The resistance of a circuit may be taken to be the sum of the opposition offered to the flow of the current.

The effects of these co-efficients vary considerably according to the nature of the current employed in

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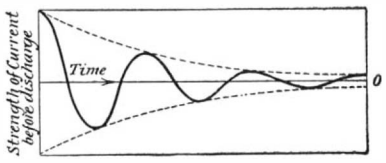
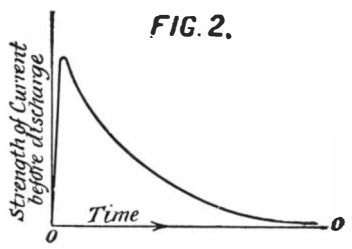


the circuit; thus the low-potential alternating currents employed for commercial purposes heat the conductor if it is of small cross-section, and radiate heat waves, in virtue of the resistance; but the inductance offers no great impedence to the current. Oppositely disposed, a current of high frequency will oscillate to and fro, with little regard to the resistance of the circuit, though the inertia of the current is greatly affected by the inductance, tending to slow down or damp the oscillations; these high frequency currents also possess the characteristic feature of dissipating nearly all their energy in the form of electro-magnetic waves.

ELECTRO-MAGNETIC THEORY.

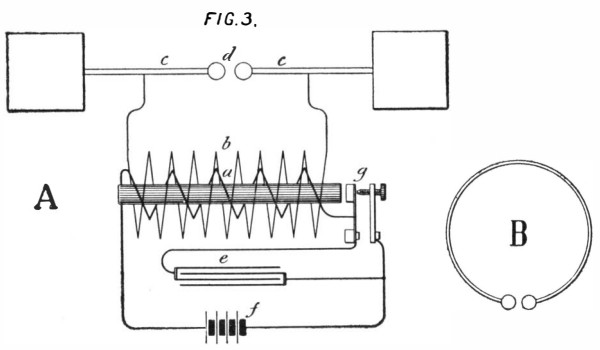
The electro-magnetic theory of light was invented by Michael Faraday, who was enabled, after a series of

FIG. 2.



laborious and difficult experiments, to demonstrate by physical methods that light, electricity and magnetism were allied to each other in a definite way. This he did by placing a cube of heavy glass of his own manufacture in the field of a powerful electro-magnet in such a way that when a pencil of light was passed through the glass the line of wave propagation was parallel to the lines of magnetic force.* Before the electro-magnet was excited an analyzer, similar to those used in polariscopes, was arranged to intercept all the waves of light. When the magnetic field was produced by the rotational current of electricity the light waves were twisted or turned through an angle sufficiently to permit them to filter through the analyzer. Proof was thus established that light and magnetism are closely related. Of electricity and magnetism the

FIG. 3.



same is equally true and more easily proven; for instance, when a current passes through a coil of wire it assumes all the characteristics of a magnet exhibiting the same curved lines of force, attraction for magnets of the opposite sign and repulsion for those of the same sign, and other phenomena of a like nature. This classical experiment and the researches of Faraday on the dielectric stresses in insulating mediums under electric strain led James Clerk-Maxwell to subsequently deduce by a delicate synthesis of Legrange's co-ordinate system† the mathematical evidence that undulatory motion in dielectrics is due to transverse vibrations of the ether or polarizations, and these polarizations are produced by changes of electric charges rapidly shearing the ether; the more rapid the movement of the electric charge, or period of oscillation, the greater will be the dissipation of energy in the development of the waves. The electric charge of an atom weighing one micromil in diameter may oscillate 434 trillion times per second propagating waves 271 ten-millionths of an inch in length, producing the sensation of red light, or the charge may vibrate with a frequency of 740 trillion times per second and send out a train of waves each measuring 165 ten-millionths of an inch in length, giving the color value of violet light; or the charge may vibrate between the limits of 271 and 740 trillion times per second, the varying wave lengths resulting in orange, yellow, green, blue or indigo light. Having determined that light-waves are electro-magnetic disturbances in the ether, caused by oscillating charges of electricity, it was not difficult to imagine a larger charge moving at a much slower rate in its reversals than atomic charges, and therefore emitting longer waves. Maxwell came to this conclusion, but to explain all the phenomena of wave emission and propagation by one ether he assumed that the velocity of transmission was in every case identical. By calculation and direct experiment this has been ascertained to be 186,500 miles per second.

Wave length as shown by a spectrum in Maxwell's time was not as extensive as it is to-day. Added to the visible spectrum discovered by Newton were band-showing waves shorter than the visible violet, and these were termed ultra-violet, and at the opposite end of the spectrum were band-indicating waves longer than the visible red; these waves were emitted by heat and were termed radiant heat or infra-red waves. That there were shorter waves than the ultra-violet and again others longer than the infra-red were postulated, but yet remained to be demonstrated.

ELECTRIC WAVES.

The present method for producing light waves by combustion is empirical and very wasteful, and the range of available wave lengths is limited by the ten-millionths of an inch. In 1888 the mathematically predicted electro-magnetic waves of Maxwell were observed by Hennrich Hertz, of Karlsruhe, Germany, who at the same time discovered the necessary apparatus for their production. The method for the production of the electric waves, employing the terminology of Hertz, is that of oscillating an electric charge of a mass instead of an atom. Prior to 1888 Prof. Fitzgerald described the conditions by which electric oscillations in masses could be set up; this was to "utilize the alternating currents surging in a circuit when an accumulator was discharged through a small resistance." This is the only method known where a longer wave than that produced by atomic vibration is desired, but Fitzgerald was unable to construct a physical apparatus to fulfill these requirements, yet the method as well as the apparatus is exceedingly simple, consisting of a Leyden jar charged by a frictional machine or electrophones and then discharged through a wire of small resistance by means of a spark-gap. When this action takes place the positive and negative charges of the Leyden jar or accumulator oscillate to and fro through the circuit formed by the wire and the spark in the air-gap, which has then a very small resistance, or mathematically expressed, the oscillations will take place if $R < \sqrt{\frac{4L}{K}}$, where *K* is the capacity of the circuit in Faraday, *R* the resistance in ohms and *L* the inductance in heneries. Fig. 1 shows in rectangular co-ordinates the curves described by an oscillatory discharge. The number of oscillations per second, or frequency, is determined by the equation

$$2^{n}\,n = \sqrt{\frac{1}{KL} - \frac{R^2}{4L^2}}$$

If the resistance of the circuit is large there will be no oscillations, but the discharge will represent a smooth curve as in Fig. 2 or by the formula $R > \sqrt{\frac{4L}{K}}$

Thus the oscillations of a pint Leyden may number 18 million per second emitting waves 16 meters in length.

The Leyden jar arrangement gave a few oscillations at each discharge and then required recharging. Hertz greatly improved upon this by employing a Ruhmkorff coil and an oscillator system shown in Fig. 3, *A*, to keep up the potential. Here a direct current was passed through the primary of the inducting coil, *a*, and automatically interrupted; this set up low-frequency, but high-potential currents in the secondary coil, *b*, the terminals of which were connected to the oscillator, *c*. The oscillator system and the currents set up in it must be regarded as absolutely distinct from the secondary coil and the currents induced in it by the primary; the oscillator and secondary coil are connected, but the purpose of the secondary currents is to charge the oscillator system automatically, and the high-frequency, high-potential currents set up by the disruptive discharge cannot flow into the secondary coil, in virtue of its great inductance. The oscillator Hertz employed consisted of two brass balls, a centimeter in diameter and separated from each other by an air-gap a few millimeters in length; these spark-balls were attached to two brass rods ending in metal

* Dr. Bruce Jones. Life and Letters of Faraday.
† Maxwell's Electricity and Magnetism.

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spheres 30 centimeters in diameter. When the two arms of the oscillator system, *c*, were charged to a sufficient potential the air-gap, *d*, was disrupted and a series of sparks filled the gap during the period of the oscillation of the electric charge. This set up in the surrounding medium stationary electric waves, also discovered by Hertz; these waves Hertz detected and measured by means of a circlet of wire having a minute spark-gap between its terminals, as shown in Fig. 3, *B*. The action of these waves in other circuits had been observed before Hertz, but the effects were attributed to electro-magnetic induction.

These are the fundamental principles underlying wireless telegraphy and upon which the whole art of syntonic methods is based; the working out of these laws constitutes the applied science of electrical resonance and in the following paper its relation to syntonic wireless telegraphy will be discussed.

(To be continued.)

THE BUILDING OF AMERICAN LOCOMOTIVES.—II.

In our issue of June 7 we pointed out that among the many great industries of America, none have more strongly marked national characteristics than the locomotive industry, and we traced the history of American locomotive building as illustrated by the growth of the American locomotive in the Baldwin Works from "Old Ironsides" of 1832 to No. 20,000, of 1902. The present article is devoted to a description of the great establishment in which an average of 1,500 locomotives a year is constructed, and from which they are shipped to almost every country in the world.

THE FOUNDRY.—The locomotive castings are made in a large foundry, measuring 80 x 400 feet. The most important castings are those of the cylinders and wheels, in addition to which there are the numerous less important fittings that enter into the make-up of a locomotive. The raw material consists of new pig iron and old stock, the latter including any good gray iron, such as old locomotive cylinders, grate bars, axle boxes, etc. The materials are melted down in three 50-ton cupolas, the output of which varies from 100 to 150 tons per day. The furnace mixture is in the proportions of 2,000 pounds of pig, 2,000 pounds of scrap, 1,750 pounds of coke and 50 pounds of marble. The foundry is served by seven jib cranes and two overhead traveling cranes.

THE CYLINDER SHOP.—The cylinder castings are cleaned and taken to a large shop devoted especially to the finishing of cylinders. One of the most interesting machines in this department is a special boring mill, designed for boring and facing the castings for the four-cylinder compound locomotives, of which this firm is making an ever-increasing number. Each casting consists of a high and low pressure cylinder, and a cylinder for the piston valve, together with half of the saddle. The mill is arranged so that the three cylinders may be simultaneously bored and faced, with a great gain of time and the certainty of accuracy of the finished work.

WHEEL-LATHE SHOP.—The wheel castings, which are cast in one piece, the rim being formed segmentally to allow for cooling strains, are taken to a special wheel-lathe shop, where the rims are turned, and the hubs are bored and faced. The wheels are forced onto the axles by hydraulic pressure and the tires are shrunk on. The axle ends are turned to an even size, and the hole in the wheel hub is bored less in diameter, by an allowance of three one-thousandths of an inch for each inch in the diameter of the axle. The two pieces are then put in a hydraulic press and the axle is thrust into the hub with a pressure which commences at 10 tons and finishes at as high as 125 tons. The tires are maintained on the rims by the initial tension set up when they are shrunk into place; but the tires of express engines are further secured by a retaining ring.

THE FORGE.—One of the most interesting departments is the forge, where raw material in the shape of wrought iron scrap, such as bolts, rivet-heads, etc., is piled up in small rectangular heap on boards, and raised to a melting heat in the furnace, from which it is taken out and hammered by steam hammers into slabs. The slabs are then put together in couples, heated and welded, the process being repeated until full-sized billets are formed measuring 8 x 8 inches by 3 feet in length. The object of this heating and reheating is to secure that thorough working of the material which is essential to the production of the highest grade of wrought iron and steel. A feature in the forge is the large battery of overhead boilers which is carried above the furnaces, the waste heat from the latter serving to raise sufficient steam to supply the whole forge shop.

CONNECTING-ROD ROOM.—A marked feature of this great establishment is the attention that has been paid to the question of labor-saving, both as regards the machines employed and the broader question of general shop management. Evidence of this is seen in the devoting of separate buildings, or of separate floors in buildings, as the case may be, to the construction of particular parts. Thus, we have already referred in this article to the wheel-lathe shop, the cylinder shop, etc. In fact, almost every detail of the locomotive of importance is machined and finished in its own particular room. One of the most interesting of these departments is the connecting rod room, where the rough forgings for the side and main rods are milled, planed, finished milled, and polished. The connecting rods are forged of mild steel. They are first centered in a lathe, then scribed out by templates, planed down to proper width; the ends milled to shape, and where they are of the new I-section, the recesses are worked out by milling the two ends, and planing out the intervening material. The brasses are forced in place by hydraulic pressure.

TENDERS.—The construction of the tenders is carried on in a separate building, one floor of which is devoted to the construction of the trucks and frames of the tenders; another floor to the laying out of the plates and the shearing and punching of the same, while on another floor the tenders are erected.

THE BOILER SHOP.—Unquestionably the boiler is today the portion of the locomotive which is receiving the most attention from locomotive designers. It is well understood that the efficiency of the locomotive depends upon the ability of the boiler to produce abundance of dry steam of the desired pressure when the engine is being worked to its fullest capacity. Steel plate is used exclusively in the Baldwin boilers, and it is received at the works in sheets of various thicknesses and sizes, some of which are as much as 20 feet long. The sheets are first marked out by standard gages, although in cases where they have to be flanged, the flanging is done previous to the template work. The rivet holes are then punched or drilled, as required by the specification; the holes of the boilers of foreign locomotives being invariably drilled, while American specifications usually call for punched holes. The boiler shop is replete with a large assortment of drills and punches, which are driven by several electric motors. Flanging as far as possible is done by hydraulic presses, one of which is shown in the accompanying illustrations. This machine is operated by two accumulators with a maximum capacity of 365 tons. The plate is heated in the furnace and the flanging is done between two suitable forms, one clamped to the lower, and the other to the upper table. Dome rings, smokeboxes, tube sheets, etc., are all formed up on this machine with great accuracy and speed. After flanging, the plates are returned to the boiler shop, where the edges are planed where necessary, or chipped with a chisel. The plates for the barrel are trimmed in a shearing press, their edges are planed, and they are then rolled to the proper curvature in the bending rolls. The boiler is now assembled for the riveting machines which, in these works, are operated by hydraulic power. The riveting dies are carried at the upper ends of two massive upright jaws which, in the larger machines, are tall enough to allow the boilers to be let down by overhead cranes, with the line of rivets between the jaws. The riveting commences at the top and is carried down to the bottom of the boiler by simply lifting the latter by the overhead traveler.

ERECTING SHOP.—The erecting shop is a fine building 160 feet wide and 337 feet long. It is divided longitudinally into two bays, each of which is served by two electric traveling cranes of 50 and 100 tons capacity. Three of our first page illustrations are taken in this shop, and they represent various stages in the erection of some of the extremely powerful freight engines which this firm is now turning out, the last of which, built for the Santa Fé Railroad, is considerably the heaviest locomotive in the world. Limitations of space forbid any detailed account of the method of erection, but briefly stated, it is as follows:

First the cylinders are set up at the height above the rails which they will occupy when the locomotive is completed, and the attached saddle is prepared for the setting of the smokebox. The engine frames are then erected and lined up. Next the complete boiler is lifted by one of the overhead cranes and placed in position, the boiler being bolted to the saddle. The tubes are then inserted and expanded. Then the driving wheels are put in place, or rather the boiler and frames are raised by the overhead cranes and lowered down upon the wheels, the journal boxes and the axles being guided in between the pedestals. At this point the engine has the appearance shown in the upper left-hand cut on the front page. Meanwhile the various boiler fittings have been put in place and connected up. The next step is the water test in which hydraulic pressure is applied at about 266 pounds to the square inch, the working pressure being 200 pounds to the square inch. Then the water is removed from the boiler and it is tested with steam at 10 per cent in excess of the working steam pressure. The connecting rods, link motion, etc., are assembled, the valves are set and the eccentrics keyed to the main axle. Meanwhile the boiler is being lagged, the same protection being placed over the cylinders. By this time the locomotive presents the appearance shown in the large cut at the bottom of the front page. The sheet iron jacketing is then placed over the boiler and cylinders. Then follows the engine test, the boiler being connected to a stationary steam plant and the engine run under steam. After the painting and various finishing touches the locomotive is ready for shipment.

THE TESTING ROOM.—Before closing, a word should be said with regard to the testing department, the work of which may be said to lie at the very foundation of the excellence which characterizes the output of this establishment. All material that enters the works is subjected to both a chemical and physical test. Every delivery of plates is numbered, as is also every plate in each boiler. When a set of plates is being shipped, say from a mill at Pittsburg, a piece is previously cut from every plate and expressed to the Baldwin testing department, where it is tested. The rejected test pieces are sent to the shipping clerk, and as the plate shipment comes in, the corresponding plate is returned to the makers. The boiler plate is of open hearth steel, of a tensile strength of 60,000 pounds to the square inch, and it must show an elongation of 25 per cent in 8 inches. By the careful system adopted of numbering every plate in every boiler and keeping a record of the test on each batch of plates, it is possible, in case of a boiler explosion, to refer to the test and obtain full data regarding the plate.

It is interesting to notice, in closing, the great increase in weight and cost of locomotives that has taken place during the past twelve years. In 1890 the average weight of a locomotive was 100,000 pounds, and its average cost $8,000. In 1902, the average weight is 150,000 pounds, and the average cost $12,000, the increase in cost having kept pace very closely with the increase in weight, and this in spite of the fact that labor and materials have risen very considerably in cost.

Imitation Meteorites.

Genuine meteorites are curiosities highly prized by museums and scientific collectors. Prof. St. Meunier, of the Natural History Museum of Berlin, paid as much as $5 per gramme for a meteorite. It is, therefore, conceivable that sharp practices should be resorted to by dealers in scientific curiosities. A band of meteorite counterfeiters was recently captured and considerable evidence obtained of very curious and ingenious methods for seducing the gullible collector. The members of this band were Corsicans. It was their practice to obtain natural rock resembling meteorites as closely as possible and then to burn them in order to produce the black crust which is one of the earmarks of every genuine meteorite. The pieces of rock were coated with lampblack, dissolved in molten sulphur. It seems, however, that this method was so crude that the deception was easily discovered, and the men were forthwith arrested.

Parisian Trees.

Paris is said to lead the world in the culture of city trees. The success of the French capital is due not so much to an admirable soil climate as to a well-organized system of caring for the trees.

In large nurseries young trees are grown and prepared for the Parisian streets. The culture of the soil is elaborate. From the very beginning the trees are pruned and staked to compel a straight growth. By frequent transplanting the roots become so hardened that they are enabled to withstand injury due to transportation. When a tree is sufficiently large, it is set out in the streets with the same care that was lavished upon it in the nursery. Often the cost of planting a single tree is $50. Whenever a storm destroys the city trees the nursery can be immediately drawn upon for another supply.

The Current Supplement.

The current SUPPLEMENT, No. 1390, opens with an interesting article on the Ruins of St. Mark's Campanile, giving some of the reasons of its fall. In a long and very complete article M. H. Dastre discusses the rôle of mosquitoes in the dissemination of diseases. Another article of interest, is that of Mr. Otis Mason, upon the Harpoon—Foremost Among Savage Inventions, the first paper of which appears in this issue. The subject of Electrolytic Production of Metals, with Special Reference to Copper and Nickel, is exhaustively treated by William Koehler, of Cleveland, Ohio. Among other articles of interest is one treating of Horned Lightning Arresters with Iron Framing; also a description of the Siemens and Halske Process for Purifying Drinking Water by Ozone. The usual Trade Notes and Recipes and Suggestions by United States Consuls are given.

Our attention has been called to a typographical error in the article on "A New Artificial Fuel," which appeared on page 92 of our issue of August 9. The statement is made that the calorific value of synthetical coal is represented by "1,300 degrees British thermal units." This should read "13,500 British thermal units."

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HOW GOLF CLUBS ARE MADE IN LARGE QUANTITIES.

BY DAY ALLEN WILLEY.

The increased love of out-door exercise in America is responsible for several new industries which have already become so important as to give employment to a large force of workmen and represent the extensive investment of capital.

One of the industries which has had its inception in the United States only within the last few years is the making of golf clubs and balls. It is unnecessary to refer to the remarkable popularity of the game, and to-day one can find "golf courses" all the way from the Atlantic to the Pacific. Organizations devoted to the pastime have been formed in every community of significance in the country, and the army of players is composed of residents of every State in the Union. During the two or three years following the introduction of the sport, players depended principally on the British factories for the contents of their bags, and the cost of the imported outfit deterred many from enjoying a day on the course. American enterprise, however, was quick to note the opportunities to manufacture and sell this class of sporting goods, and some of the larger companies making bicycles, tennis racquets, croquet sets and base-ball clubs added a golf department. So extensive has the industry become that in the West as well as the East are plants employing over five hundred hands each, whose entire product is the golf club. It forms one of the principal industries of a town in Massachustetts, where one factory turns out a thousand clubs daily in the busy season.

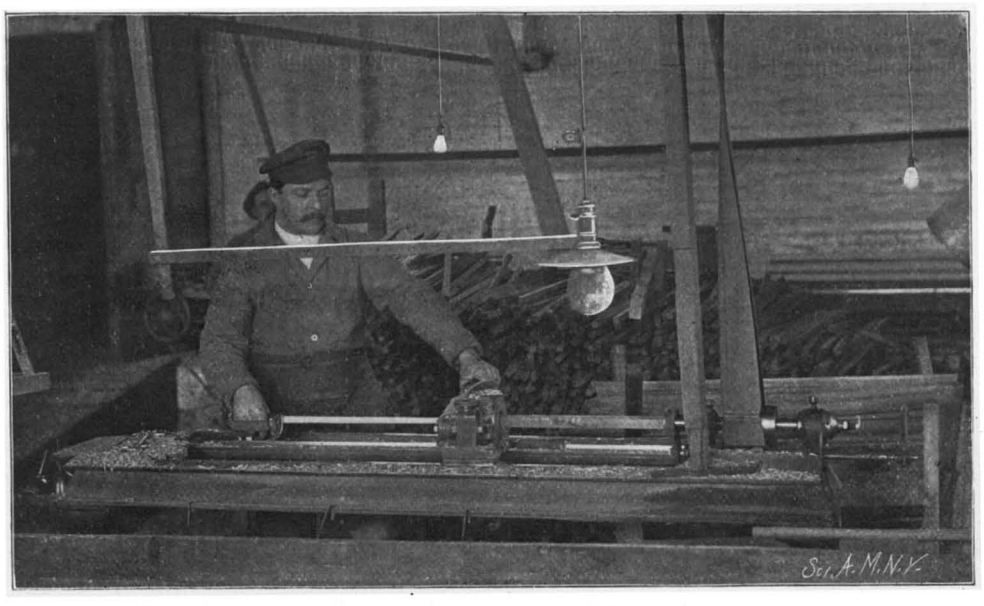
In spite of its apparently simple construction the golf club passes through an elaborate series of processes before it is ready for the market. It consists of two main parts, the shaft and head. As the former is usually of wood, material is selected with a view not only to its hardness, but toughness; the best quality of hickory is preferred for the purpose, each tree being carefully examined in the forest before it is cut down. The wood comes to the factory sawed into planks of a suitable thickness, and is again sawed into square strips of the requisite length. A simple form of turning lathe is used to round off or turn the shafts, but as yet no power device has been invented which will complete the shape, and considerable labor is required with hand tools to work it down to the exact dimensions; this operation necessitates long experience and a good eye to insure the proper tapering of the shaft. So particular is the manufacturer that sometimes 50 per cent of the sawed shafts may be rejected on account of some slight defect before unnoticed.

Hammering Steel Heads in the Blacksmith-Shop.

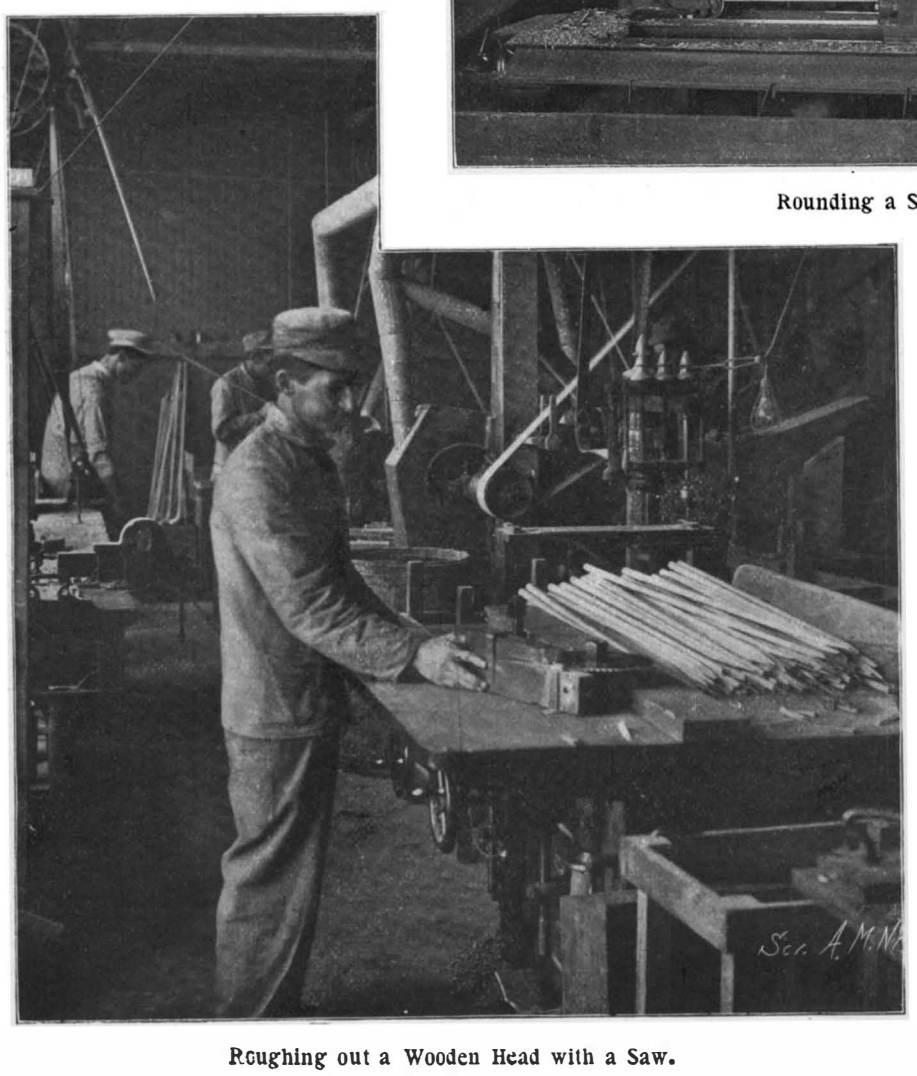
The next process is to join the shaft to the head—another operation requiring much skill, as a perfect fit must be insured to withstand the strain at the joint. Dogwood and persimmon are most extensively used for the wooden head. They come to the head-maker in blanks from the saw. A machine specially designed for the purpose cuts them down to a rough semblance of the head, but here again the rest of the work must be done by hand, and chisel, file and sand paper are indispensable. The shaft and head are spliced one to another by means of a strong cord. The operator winds about the joint a fine cord, made of waterproof material, each strand fitting so closely and evenly that it seems a part of the wood itself when the whipping is completed. The so-called iron clubs are composed almost entirely of steel, as it is found that a mild grade of this material is best suited for these clubs. First quality heads are made entirely by hand, and here the blacksmith's anvil and hammers come into play, yet the cleek makers become so expert in their line that they can duplicate almost any model of head, not only in size, but almost precisely in shape, so deft are they in wielding the hammer. Most of the metal heads, however, are drop forgings, and to this process is largely due the greatly reduced cost of the golf outfit, for it saves much time and labor. All of the heads, however, are finished on polishing spindles which, revolving rapidly, act upon the surface as sandpaper does on wood, removing all rough spots and giving them the luster of silver when the operation is completed.

The putting on of the grip or handle is done so rapidly that a skilled workman will complete the operation in a little over a minute. For the best clubs horsehide is used entirely, but sheepskin is found to be a fair substitute, and is wound on the other grades. The hide is cut into strips of the proper length and width by machinery, but the workman wraps the grip around by hand with a few dexterous motions, clinching the loose end with small brads or glue. Sometimes the entire shaft is covered with the finishing coat of varnish, but first the wood is saturated with shellac, which enters the fiber and plays an important part in protecting it from the weather. Over this is placed the varnish, and after a vigorous rubbing the club is ready for the player.

Scotland is the home of the most expert makers of the golfer's outfit, and to them is due much of the skill which has been acquired by the Americans. A large number of



Rounding a Shaft on a Lathe.



Roughing out a Wooden Head with a Saw.

Finishing the Shafts with File and Sandpaper.

THE MAKING OF GOLF CLUBS.

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artisans of the old country have come to the United States to ply their trade, tempted by the higher scale of wages. One enterprising corporation has a colony of Scots at its New England factory. It is an interesting fact that the best workmen are players themselves, and skill in handling the clubs has given them a knowledge of the proper shape and "lay" of the clubs which they could not otherwise obtain.

THE BATTLESHIPS "CONNECTICUT" AND "LOUISIANA."

The two battleships for which Congress made provision by act of Congress of July 1 last, will be, when finished, the finest of their class in any navy. Steadily, season by season, the size of these great fighting machines has grown. To-day we have reached a displacement of 18,000 tons full laden, and there is no assurance that the next of the type won't be still larger twelve months hence. Four million, two hundred and twelve thousand dollars seems a pretty large sum to pay for the hull and machinery of a fighting ship—especially when the guns, armor, miscellaneous equipment, and stores complete, when ready for sea will demand quite a couple of million more. But the peace of the nation calls for these safeguards, and the welfare of every one of our rich ports demands this protection in time of war: it is treasure spent the better to guard still greater wealth.

Before a line of the present vessels was drawn the Board on Construction thoroughly discussed their essential features and, incidentally, settled for a long time to come many much-debated questions which had provoked differences of opinion for years back. Sheathing and coppering were disapproved; the extent and thickness of armor protection were increased; the batteries were improved and better sheltered; torpedoes were relegated to other classes of vessels; the application of electrical motive force was considerably widened; and the coaling facilities (the bugbear of most vessels) were amplified vastly, while the ammunition supply, by the introduction of a very novel feature, was increased to a degree considerably in extent of possible rates of fire. The advantage of this, apart from a bountiful feed to the gun station, is the speed with which a ready supply can be brought up to the firing position within a short while.

The general dimensions and features of the ships are: Length on load water-line, 450 feet; breadth, extreme, at load water-line, 76 feet 10 inches; displacement on trial, not more than 16,000 tons; mean draft to bottom of keel at trial displacement, 24 feet 6 inches; maximum displacement, full load, 18,000 tons; mean draft at maximum load, 26 feet 9 inches; coal carried on trial, 900 tons; total coal bunker capacity, 2,200 tons; steaming radius, at 11 knots, about 7,000 knots; steaming radius, at full speed, about 2,500 knots; maximum speed, not less than 18 knots; maximum indicated horse power, estimated, 16,500; complement (flag-ship) officers, seamen and marines, 801.

Trial displacement will mean vessel and equipment complete with 900 tons of coal, 66 tons of feed-water and two-thirds supply of ammunition and general stores.

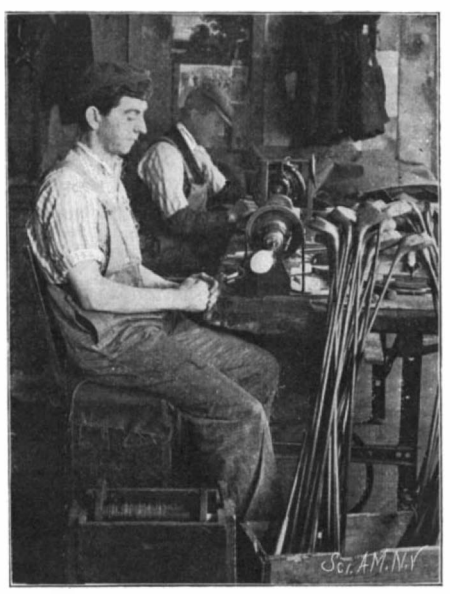
The hulls will be of steel throughout with the usual cellular subdivisioning of the double bottom and the inner body. Some forty-odd of the water-tight doors and five of the armor gratings are to be closed by power from a central emergency station. These doors can be independently opened and closed by power—the pressure of a button starting the work, and their action is sufficiently slow not to catch anyone in transit. The advantage of the system is obvious in case of accident. The freeboard, at the line of the main deck, is nearly 18 feet, and runs uniformly from bow to stern. This insures good sea-keeping qualities, the ability to work the main battery in any kind of fighting weather, and airy and commodious quarters for officers and enlisted men, besides plenty of room for the stowage of hammocks where they can be kept dry and well-aired—a feature vital to the health of the crew. The arrangement of the forward upper bridge is somewhat novel, affording a very wide field of observation, while the glazed bronze housing or screen at the center will completely shelter the people at the wheel from driving spray. There will also be a bronze chart house on the lower bridge deck (non-magnetic) in which the standard binnacle will be kept free from the influence of steel work. The conning tower on these ships, which will be 9 inches thick, is located immediately below the upper bridge, a deck higher than heretofore. This insures a wider field of observation for the commanding officer in action. The armored tube from this tower to the protective deck is 6 inches thick. A signal tower, 6 inches in thickness, of steel, is located aft on the superstructure deck just abaft the mainmast.

The hull is primarily protected by a broad water-line belt of armor 9 feet 3 inches wide throughout the range of maximum thickness and 8 feet wide thence to the bow and to the stern. Amidships, for a distance of 92 feet, this belt will be 11 inches thick. Thence forward and aft, respectively, for a distance of 93 feet, it will taper from 9 to 7 inches. The next run of 37 feet will range from 7 to 5 inches. For 34 feet following this the armor will be 5 inches thick, and thence to the bow and to the stern it will diminish to 4 inches. The sides immediately above the water-line belt as high as the gun deck and for a fore-and-aft distance of 284 feet will have armor 6 inches thick, while the space occupied by the 7-inch guns on the gun deck will be protected by 7 inches of armor for a distance of 236 feet. Athwartship bulkheads at the ends of the thickest side armor will be 6 inches thick, and athwartship bulkheads at the ends of the lighter side and casemate armor will be respectively 6 and 7 inches thick. The protective deck, which extends from bow to stern, will be an inch and a half thick on the flat over the engines and boiler spaces; on the slopes forward and aft it will be 5 inches thick. A coffer dam 30 inches thick will be worked from end to end of the ships between the protective and the berth decks; and on the berth deck, forward and abaft the transverse armor respectively, there will be another coffer dam of the same thickness, but only 3 feet in height. The protection thus afforded the ends of the ships is pretty thorough.

The armament will be: Main battery—Four 12-inch, eight 8-inch, twelve 7-inch breech-loading rifles. Secondary battery—Twenty 3-inch, 14-pounder rapid-fire guns, twelve 3-pounder semi-automatic guns, six 1-pounder automatic guns, two 1-pounder semi-automatic guns, two 3-inch field pieces, two machine guns of .30 caliber, six automatic guns of .30 caliber.

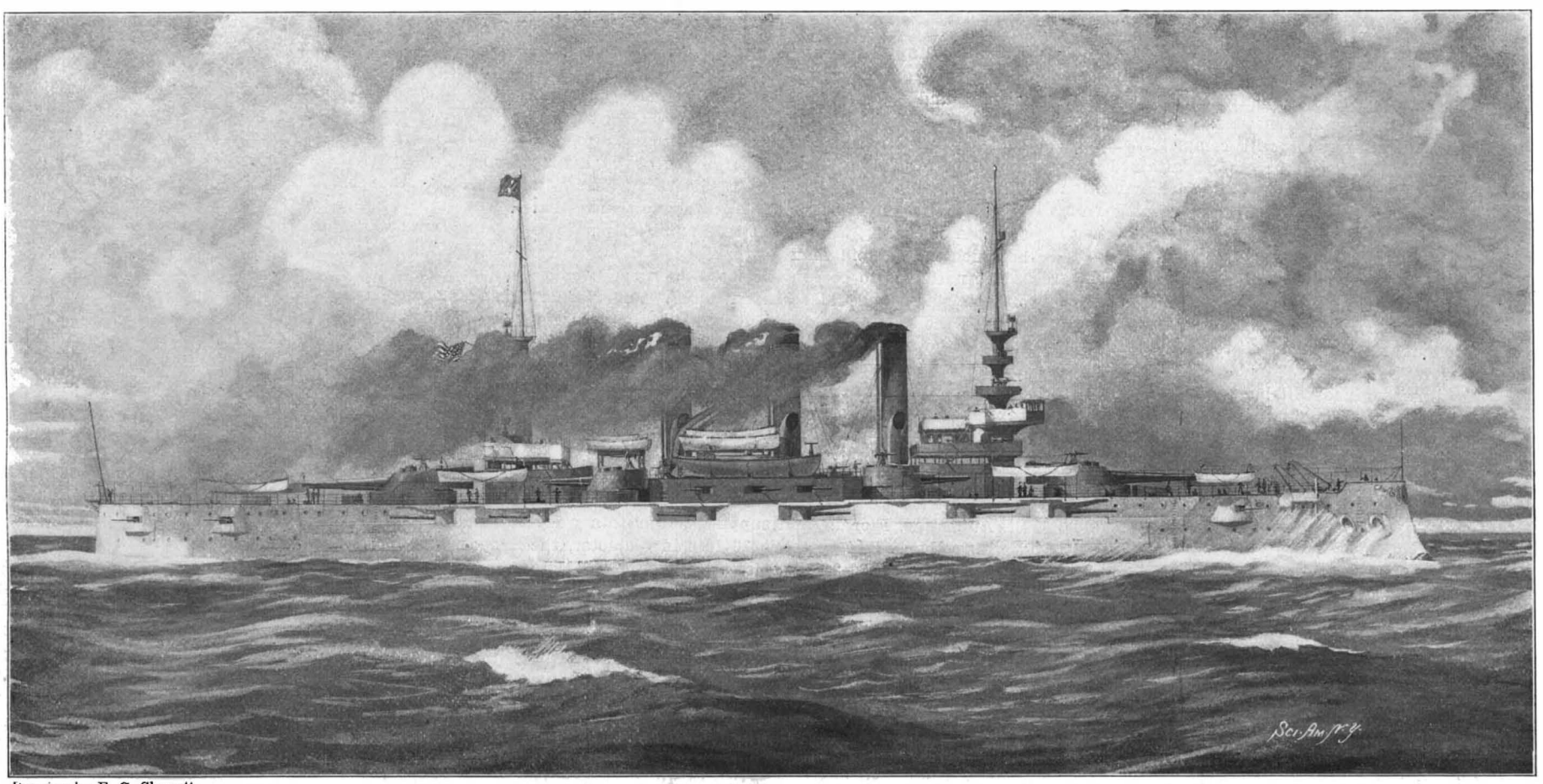
The 12-inch guns will be mounted in two elliptical balanced turrets, of the barbette type, with slanting faces. These turrets will have face plates 12 inches

Putting on the Grip.



Winding the Joint of the Head and Shaft.

THE MAKING OF A GOLF STICK.



Drawing by F. C. Skerrett.

Displacement: on trial, 16,000 tons; maximum, 18,000 tons. **Speed:** 18 knots. **Maximum Coal Supply,** 2,200 tons. **Armor:** Belt, 11 inches to 4 inches; turret guns, 6½ and 12 inches; broadside guns, 7 inches. **Armament:** Four 12-inch, eight 8-inch, twelve 7-inch, twenty 3-inch, twelve 3-pounders, eighteen 1-pounders and automatics. **Complement: 801.**

FIRST CLASS BATTLESHIP "CONNECTICUT"

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thick, the rest of the armor being 8 inches thick, with top plates of 2½ inches. The barbettes, which will rise from the protective deck to about 4 feet above the main deck, will be generally 10 inches thick, except to the rear of the transverse bulkheads, where it will be 7½ inches thick. These turrets will turn through arcs of 270 degrees, and be under complete electrical control, as will also be their hoists and their loading and training mechanisms. The 8-inch guns, also mounted in pairs, will be placed in four turrets of the same type, on the main deck, at the corners of the superstructure. The 8-inch turrets will have front plates of 6½ inches, and a general thickness elsewhere of 6 inches. Their barbettes will be 6 inches thick where exposed and 4 inches thick at the rear. The tubes leading below to the protective deck will range from 3¾ to 3 inches thick for the lower half. The top plates will be 2 inches thick. These turrets, also under electrical control, will swing through arcs of 120 degrees. The 7-inch guns will be mounted in two broadsides on the gun deck and protected by continuous armor 7 inches thick and stout shields 3 inches thick. The guns will be on pedestal mounts, and the re-entering ports will admit of stowing the guns within the line of the side armor, the advantages of which are plain in rough weather and while lying at a dock. The arcs of fire of these pieces will be 135 degrees, and the forward and the after gun on each broadside will be able to fire directly ahead and directly astern, respectively, thus giving a bow or stern fire of two 12s, four 8s and two 7s from the main battery. The 14-pounders will be variously distributed. There will be one on each bow forward on the gun deck, two on each quarter aft on the same deck, three in a bunch amidships on the main deck, and the rest on the hammock berthing fore and aft on the superstructure deck. Where mounted on the main deck and the gun decks, they will be protected by local armor, 2 inches thick, of nickel steel. The 7-inch guns are separated one from the other by splinter bulkheads of nickel steel 2 inches thick.

The 3-pounders are mounted on the tops of the turrets and on the superstructure deck and bridges, while the smaller pieces are placed in the fighting tops. All of these guns have wide arcs of fire and are placed where they can best do their prime work of repelling torpedo-boats, both surface and submarine, and of attacking an enemy's light armor and unprotected parts and open gun-stations.

The ammunition and shell rooms are so arranged that about one-half the total supply will be carried at each end of the ship. The allowance is a very liberal one, amounting to nearly 600 tons. The ammunition for the 7-inch and smaller rapid-fire guns will be conveyed by hoists directly from the ammunition rooms or passages to the deck on which required, or as near that as possible. These hoists will be driven at a constant speed by an electric motor and will be arranged to deliver seven pieces per hoist a minute. The 7-inch guns will have a hoist apiece. For the 3-inch there will be fourteen hoists, and for the 3 and 1-pounders there will be combined hoists. To supply the 7-inch hoists there will be four ammunition conveyors, operated electrically, fitted in the passages and running directly from the handling rooms to the base of the hoists. These conveyors are really traveling sidewalks, and all the men have to do is to pass them from the door to the moving platform, and the platform delivers them wherever needed. This is an essentially novel feature, and will completely revolutionize the rate of delivery heretofore attained anywhere. The turret guns have regular ammunition hoists operated by electricity and leading directly from the handling rooms or the ammunition passages to the turrets.

A comparison between the batteries of these ships and the British battleship "Commonwealth," rates of fire and muzzle energies being duly considered, show the "Connecticut" and "Louisiana" to be distinctly superior.

The propelling engines will be vertical, twin-screw, 4-cylinder, triple-expansion engines, having cylinders of 32.5, 53, 61, 61 inches in diameter, with a common stroke of 4 feet, and a speed of 120 turns a minute at 18 knots. These engines will be in two separate watertight compartments. Steam at a working pressure of 250 pounds will be supplied by twelve water-tube boilers of the Babcock & Wilcox pattern, and they will have a total grate surface of not less than 1,100 square feet and a total heating surface of 46,750 square feet. Forced draught will be on the closed ash-pit plan with a pressure of 1 inch of water. The three funnels will be 100 feet above the keel line. Feed-water will be carried in the double bottom. The refrigerating plant will be equal to the cooling effect of a daily output of three tons of ice. This plant will be of the dense-air type and will have leads to the magazines for use in case of a dangerous rise of temperature therein. The evaporating plant, of not less than four units, will have a daily output of 16,500 gallons of fresh water, and the distilling apparatus will have a diurnal capacity of 10,000 of drinking water. All of the ventilating blowers will be driven by electricity—those for forced draught by steam. There will be a laundry, a mechanical bread-mixer and a special bakery plant apart from the regular ship's galleys.

The electrical generating plant will consist of eight 100-kilowatt steam-driven generating sets, all to be of 125 volts pressure at the terminals. There will be six electrically driven generators for supplying power to turret turning motors. The ship will carry six searchlights of 30-inch pattern, and there will be no fewer than 1,100 electric light fixtures otherwise, besides truck-lights, signal lamps and a number of diving lamps. There will be six portable ventilating sets of ¼ horse power and forty-five 1-12 horse power desk and bracket fans, and eight 1-6 horse power bracket fans. These, with the thirty-three large blowers, will be able to keep up a pretty comfortable circulation of fresh air. All boat cranes, anchor cranes, deck winches, ash hoists and tools in the machine shop will be driven by electricity.

Wood will be reduced to a minimum, and all of it, with the exceptions of decks exposed to weather and some few articles of furniture, will be fireproofed. Asbestos sheathing and mill board will cover the outer hull plating in living spaces; and metal ceiling will be fitted to the outer hull in all living quarters not sheathed with non-conducting material. Quarters will be provided for an admiral, his chief of staff, the commanding officer, nineteen wardroom officers, nineteen junior officers and ten warrant officers.

A WATER-WHEEL DRIVEN BY A FLOWING WELL.

The ships will carry twenty boats, including two 36-foot steam cutters and a fine 50-foot picket launch, which will be especially useful for shore communication and in going from ship to ship in rough weather, and also in convoying landing parties.

The coaling arrangements will be quite unique. They will consist of six electrically-driven deck winches and a dozen booms—six on each side, together with all necessary fixed chutes, etc. The booms will be so placed that three can be worked to a barge, and it will be possible to coal from four barges at a time—two on each side. Some of the working gear will be automatic. It is not possible to tell now just what the rate of coaling will be, but it is manifestly sure to be much more rapid than any present system.

The nation is to be congratulated upon the promise of these ships; and Chief Constructor F. T. Bowles has marked the first ships designed under his administration of the Bureau of Construction and Repair with a stamp of distinct advance over anything yet turned out by the department, and every contributive bureau has lent its best efforts within its province.

POWER FROM AN ARTESIAN WELL.

Our engraving shows perhaps the only power water wheel in America driven by an artesian well. It is at St. Augustine, Florida, and supplies power to a woodworking shop. The wheel is 16 feet in diameter, the well 6½ inches and 240 feet deep. Since the well does not supply power enough, however, a second well has been driven nearby to reinforce the present one. The new well is 8 inches in diameter. The contractor first drove an 8-inch iron tube about 150 feet through the sand, when he struck bedrock. On drilling into this some 50 feet, water overflowed in considerable quantity, but it was not until he penetrated quite through the rock strata (about 100 feet thick) that the well gave a normal volume of water.

The Navy Department has decided for experimental purposes to equip the torpedo boat "Rogers" for the use of oil fuel.

Engineering Notes.

It is said that by June, 1903, the Tehuantepec Railroad, across the isthmus of that name in Mexico, will compete with the Panama route and the American overland lines for a share of the shipments between the Atlantic seaboard and the Pacific coast.

The aggregate tonnage of launches on the Clyde during the month of May constituted a record which has only been twice before exceeded in the whole history of Clyde shipbuilding. Twenty-three steamers were launched, of a total of 54,960 tons; three large sailing ships, totaling 5,676 tons; two steam yachts, of a total of 465 tons, and six sailing yachts of an aggregate of 135 tons. The shipbuilding industry on the Clyde is remarkably prosperous at the present time, and notwithstanding the above abnormal output of new vessels the berths are filled up with fresh orders amounting to about 50,000 tons.

The British government has been requested to sanction the construction of an important railroad from Berbera, on the North Somali coast, to a spot adjoining Harrar, just inside the Abyssinian frontier, to provide rapid communication between the latter country and the sea. The distance is about 220 miles. The railroad is to be a lightly built one, and will cost $3,750,000 to construct, unless the promoters follow a route over the formidable Harrar escarpment. On this outlay the government is asked to guarantee a return of 3 per cent—a relatively small sum. The Emperor Menelik favors the construction of the line, which would tap the trade of a most wealthy district and afford an easy and direct route for the conveyance of British manufacturers into Abyssinia, in which country there is a heavy demand for such goods.

Owing to the extensive and frequent bucklings that have recently occurred upon several of the torpedo boats of the British navy, the English Admiralty propose carrying out a series of severe experiments to ascertain the amount of "hogging" and "sagging" strains the torpedo boat will withstand. The inability of this type of craft to stand the varying strains imposed upon them by wave action, especially in rough seas, is attributed to structural weakness. The Admiralty are preparing one of the drydocks at Portsmouth specially for the tests, which are to be carried out on the torpedo destroyer "Wolf." The vessel will first be "sagged" by being suspended by the head and the stern only from two platforms, one at each end, all support being removed from beneath the middle portion of the ship. She will be "hogged" by being balanced in the center of her length across a pile of timber, so that the full weight of the vessel is thrown fore and aft. By means of these experiments the Admiralty anticipate obtaining reliable and conclusive evidence as to whether, as is generally contended by marine experts, a destroyer's hull is so weak that her back will break when she is lifted by the sea fore and aft in such a manner that there is a wave hollow beneath her center, or when a wave lifts her amidships, leaving stem and stern unsupported.

Engineering says that the Cunard Steamship Company is with characteristic caution considering the question of 24-knot ocean liners in all its bearings. Hitherto the company has merely asked three firms, Vickers Sons & Maxim, of Barrow; the Fairfield Shipbuilding Company, of the Clyde, and Messrs. Brown, to submit three alternative designs for a vessel 700 feet long and with speeds of 24, 23 and 18 knots an hour, along with an estimate of the first cost and information regarding crew and coal expenditure. In this way the company raised the whole question of whether the game was worth the candle. The "Campania" and "Lucania," of 12,500 tons burden, to make 22 knots speed developed 28,000 indicated horse power. To make 23 knots would necessitate a larger and more costly ship, besides an additional 8,000 indicated horse power; while to make 24 knots it is estimated that a ship would require 48,000 indicated horse power. It would thus come about that to add two nautical miles to the hourly speed would mean an additional 290 tons of coal to be consumed daily. This would mean a consumption of 750 tons per day, or 1.3 tons per mile steamed. Engineering points out that an 18-knot steamship would consume less than half this amount of coal per day, while the expenditure in wages and engineering would be correspondingly lessened. It remarks, futhermore, that such a vessel could profitably carry a large cargo, as her machinery would require only half the weight and space of the swifter vessels. It does not pay to take a cargo at a high speed. On the other hand, there is the opportunity of securing higher passenger rates. Many Americans insist on traveling on fast ships. There is also the factor of larger Admiralty subventions made justifiable by the ships being an addition to the resources of the country in time of war. It is stated that in consequence of the efforts of the American syndicate controlling the Dominion Line of steamers to capture the Boston trade the Cunard Line has decided to build a new ship to strengthen its traffic with that port.

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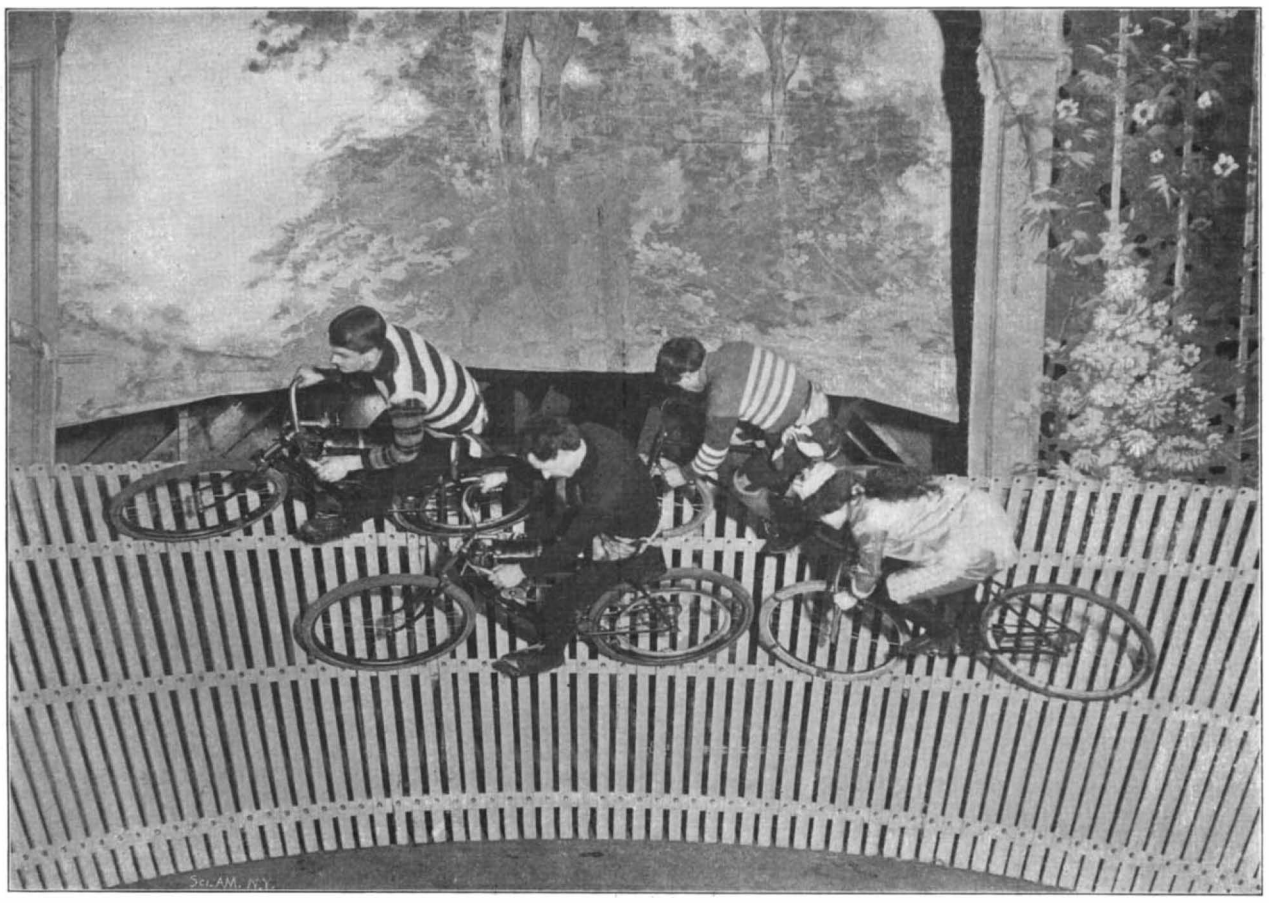
MOTOR-PACED RACE ON A CYCLE WHIRL.

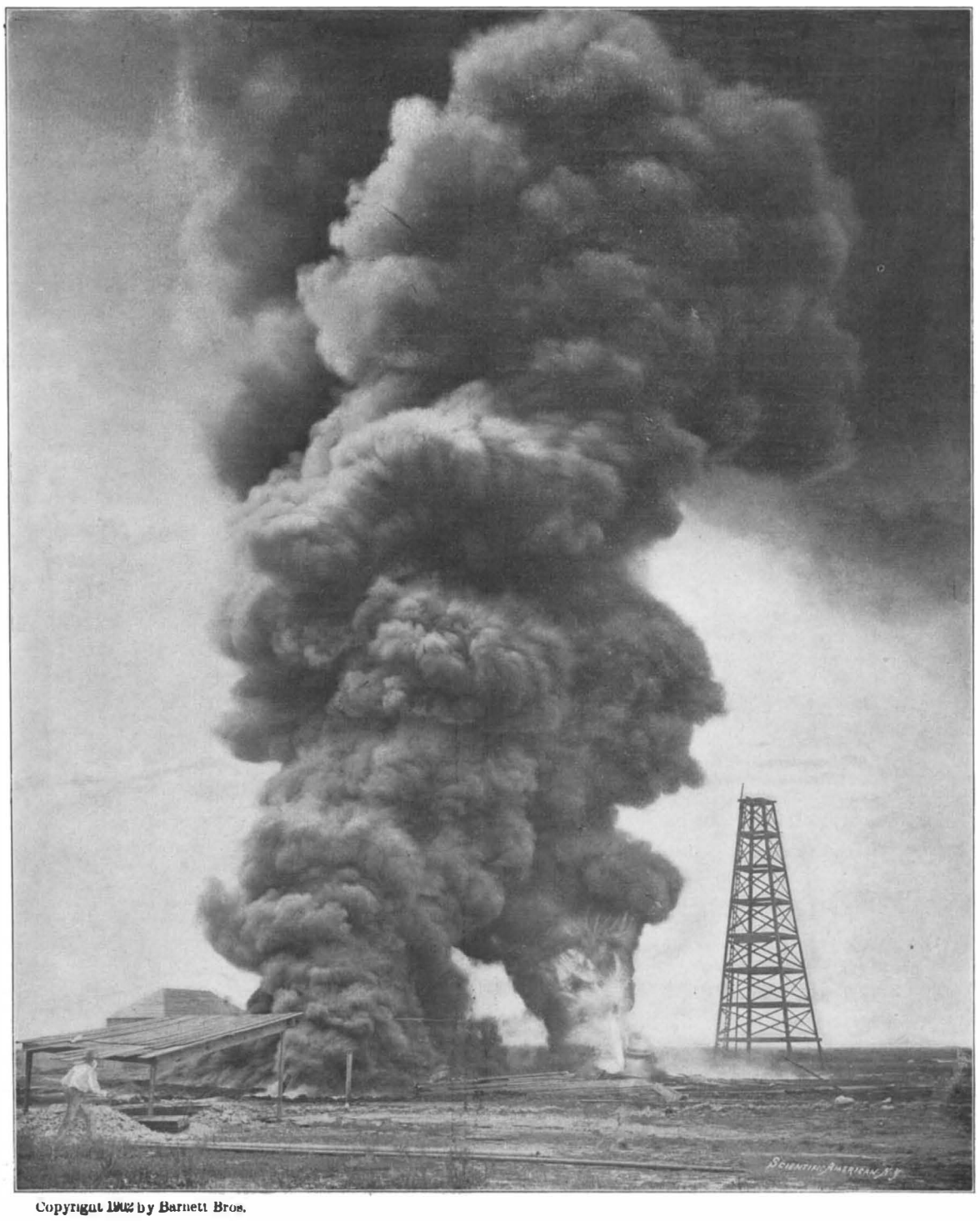
Encouraged by the success which attended the presentation of the first cycle whirl, in which cyclists competed with each other on a circular track small enough to be placed on an ordinary theater stage, it occurred to one of the leading exponents of bicycle racing that a cycle whirl constructed for motor-paced racing would be equally popular. Of course this involved a much higher rate of speed, greater strains on the structure, and a considerably greater risk. The circular track of the first cycle whirl had a pitch of somewhere in the neighborhood of 45 degrees; but with the higher speeds necessary with motor cycles it was necessary to raise the pitch from 45 degrees to 60 degrees, and the new track, which looks for all the world, as will be noticed from the engraving, like a circular fence, was built with the slats inclined only 30 degrees from the vertical.



MOTOR-PACED RACE ON A CYCLE WHIRL.

Inclination of track only 30 degrees from the vertical.

In determining the proper pitch of one of these whirls, the elements to be taken into account are the speed, the curvature and the resulting centrifugal force. When the motors with the racing contestants are speeding at a rate of from twenty to thirty miles an hour around a track, the centrifugal force tending to throw the weight to the outside of the circle has to be counteracted by inclining the rider and his wheel at such an angle to the inside of the circle that the pull of gravity downward shall, as closely as possible, equilibriate the pull of centrifugal force to the outside of the circle. The resultant of the equilibrium will be a force acting normally to the surface of the track. Theoretically it would be possible to run a wheel at seventy-five or a hundred miles an hour around a track of the size shown in our illustration. Of course, the track in this case would have to be almost perpendicular, and the wheels would have to be built up of exceptional strength; for it will be readily understood that the resultant of gravity and centrifugal force acting normally to the track through the wheels, would exert a pressure on the track much greater than that which is due to the weight of the rider and his wheel when he is traveling on level ground. In the so-called race which is herewith illustrated, the woman rider invariably won the event. All that she had to do in passing her opponent was to run down to the lower edge of the track, where, of course, she was covering much less distance in each lap than her opponent who was riding on a circle of larger diameter. Great care had to be taken in the selection of the material and in the construction of the track. It was strongly braced with iron and securely bolted at every intersection of the slats with the circular frame. Judging from the speed that was accomplished, the track must have presented less friction than one would suspect. The effect produced when the four riders were moving at full speed was most interesting. They appeared at times to be standing out almost horizontally from the slats; and the whole exhibition was an excellent object lesson in practical mechanics.



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BURNING OIL GUSHER, JENNINGS, LA.

Struck by lightning July 15; extinguished July 22 by streams of steam and water from a dozen boilers.

BURNING OIL GUSHER IN LOUISIANA.

There is all the difference in the world between the burning of an oil tank, an incident which is familiar the world over, by reason of the many photographic reproductions of such a sight and the stupendous conflagrations shown in our accompanying illustration of a burning oil gusher. The rapidity of the combustion of a burning oil tank is limited by reason of the fact that combustion can take place only on the surface of the oil, and even then it is governed by the amount of oxygen that can rush in from the surrounding atmosphere to feed the fire. It is a slow process that takes many hours to complete. In the case of a burning oil gusher, however, the oil has been thrown into the air to a height of a hundred feet or more and at the rate of from 50,000 to 150,000 gallons per day. As it rises the resistance of the atmosphere causes the oil to break into a far-spreading spray, and this subdivision enables the oxygen of the air to mingle with the burning mass and produce the enormous conflagration shown in our engraving. This gusher was struck by lightning on July 15 and ignited. The fire burned with extraordinary fierceness for seven days and nights. It was only extinguished after streams of steam and water from no less than a dozen boilers, which had been gathered at the well, were concentrated on the fire.

Prof. Bohuslav Brauner contributes to a recent number of the Journal of the Russian Physical and Chemical Society a paper on the position of the rare earths in Mendeléeff's periodic system of elements. After mentioning his experimental and theoretical work concerning the elements lanthanum, cerium, praseodymium, neodymium, thorium, etc., the author discusses the position of these elements in the periodic system, and the four different ways in which it may be attempted to place them in it. With Mr. Steele, of Melbourne, he comes to the conclusion that this group of elements represents a sort of node in the periodic system, between cerium and an unknown element which has the atomic weight of 180. This interperiodic group is a continuation of the eighth series, which ends with the platinum elements; gold appears in such case as the first member of the ninth series, and not of the eleventh. In the twelfth series the first members are, probably, radium, thorium and uranium. This addition seems, in Mendeléeff's opinion, to deserve serious attention.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

RAKE.—A. S. ELLIOTT, Mechanisville, Iowa. This rake is specially adapted for use in gathering cut stalks, which lay in windrows, into shocks, preparatory to burning or otherwise disposing of the stalks. The invention embodies an improved construction of the rake head in which the teeth are clamped against possible endwise or lateral displacement.

CULTIVATOR.—W. F. CAHOON, Sumrall, Miss. The cultivator embodies an improved form of bent teeth which operate in connection with the frame in such manner that they can be adjusted to throw to or from the plant, as may be desired. The teeth may be adjusted independently of each other and the implement acts to thoroughly pulverize the soil before it is shoved up to the plant.

Apparatus for Special Purposes.

STEAM-HEATING SYSTEM.—W. E. ROYS, Richmond Hill, N. Y. This is a gravity steam-heating system and it is so arranged that the user can control the amount of heat radiating from any radiator in the system to insure proper heating of rooms to a predetermined degree, and to provide a free return of the water of condensation to the steam generator.

APPARATUS FOR DEFECATING LIQUIDS.—J. E. HATTON, Santo Domingo city, Santo Domingo. This apparatus is arranged to purify liquids, such as cane juices, and the construction is of such character that the work done will be automatic, thorough and continuous. Means are also provided for regulating and maintaining a uniformity of heat while the work is in progress, and also to regulate the alkalization of the liquid.

SOOT-CLEANER FOR STEAM-BOILERS.—WILLIAM EICHELBERGER, Windber, Pa. Mr. Eichelberger has designed an improved soot-cleaner for steam-boilers, whereby the deposits of carbon or soot on the interior surfaces of the boiler will be removed by the pressure of gaseous fluids, such as steam or air, and the accumulated soot conveyed and discharged into an ash-pit or any other place.

AIR-COOLING, DRYING AND PURIFYING APPARATUS.—W. L. MOORE, Washington, D. C. This apparatus will be found useful for cooling, drying and purifying the air in buildings and other places, and for keeping meats, produce or anything that requires low temperature. The air is passed through metal pipes which are surrounded by melting ice and chloride of sodium, chlorid of calcium, or other chemicals to lower the melting point of ice, and as the air passes through these pipes, it is caused to lose more of its heat and finally by gravity to be discharged through the bottom of the apparatus.

RETORT FOR WOOD DISTILLATION.—W. B. CHAPMAN, Boyne City, Mich. The retort and the setting for the same are adapted for use more particularly in wood distillation, for the production of wood-alcohol, charcoal and other by products. The retort consists of corrugated sheets of relatively thin metal anchored at suitable points along its length, which sheets by departing from straight lines and buckling or curving sidewise, more or less, from expansion and contraction, take up locally all destructive strains.

FURNACE FOR RETORTS.—W. B. CHAPMAN, Boyne City, Mich. The invention relates to a novel form of furnace and furnace setting for retorts, especially such as are used in the distillation of wood to produce wood-alcohol. The construction enables the use of solid fuel, instead of natural gas, whereby a uniform heating is obtained at much less cost and the furnace is useful in localities where natural gas cannot be obtained.

PULP-SEPARATOR.—J. K. MCLAUGHLIN, Au Sable Forks, N. Y. The invention relates to the manufacture of wood pulp by the sulphid process and provides an improved separator for pulp mills which is arranged to insure a quick and thorough separation of the stock from the acid.

Electrical Apparatus.

CIRCUIT-CLOSER.—D. F. MULKEY, Soddy, Tenn. This improved circuit-closer is particularly adapted for burglar alarm systems in banks, hotels, residences, etc. The circuit-closer may be closed by a person stepping upon it, or it may be operated by the opening of a door or window.

COMPOSITION FOR USE IN SECONDARY BATTERIES.—C. T. J. OPPERMANN, 2 Wynyatt Street, Clerkenwell, London, England. Mr. Oppermann is the inventor of improvements in secondary batteries which increase the efficiency and durability of the battery by rendering the active material harder and less liable to disintegration and insuring more complete and more uniform chemical action, so as to avoid buckling of the plates.

Engineering Improvements.

AUTOMATIC CURRENT-MOTOR.—JOHN ROEH, Oroville, Wash. This current-motor is adapted to convert the energy of a flowing stream into reciprocating or rotary motion for driving a pump or other mechanism. The motor can be used in shallow streams as well as in streams of considerable depth, and all the working parts are located above water, whereby they may be easily adjusted by the mechanic.

Hardware.

NUT-LOCK.—FRANK HART, Newcastle, Pa. This improved nut-lock is applicable to all classes of machinery wherein it is desired to lock a nut from turning. The device consists of a washer having flanges adapted to engage the side faces of the nut and anchor lugs, which prevent the washer from turning.

HAND DOWELING-GAGE.—J. CORLISS, New York, N. Y. This gage is particularly useful in building frames of doors, windows and the like, and insures the boring of holes with extreme rapidity and absolute accuracy. The instrument may be readily adjusted to work of all sizes, and may, therefore, be found useful in all branches of house-carpentry.

COUPLING FOR CABLES, ROPES, ETC.—T. DARLING, Marietta, Ohio. The invention provides a simple construction for coupling cables, which may be easily and quickly applied or removed. In well-drilling machinery the operating engine is often located remote from the scene of operations and an intermediate cable is employed. The attachment of the cable to the several parts or the union of lengths of the cable must be performed with exactitude to secure the best results, and this may be done with Mr. Darling's improved coupling.

Machines and Mechanical Devices.

MORTISING-MACHINE.—C. J. SEAQUEST, Silverlake, Wash. Mr. Seaquest in this invention provides a handy tool for woodworkers. It comprises a mortising machine which is of simple construction and may be actuated by hand in a very easy manner to accurately form mortises in woodwork.

AUTOMATIC GRAIN WEIGHER.—A. and J. H. MCLEOD, Marietta, Kans. The grain weigher belongs to that class in which the grain is received in a stationary hopper and discharged therefrom into a movable weighing hopper so connected with the graduated weighing machine as to tilt the same when duly filled, whereupon the gate of the hopper is opened to allow discharge of its contents. The improvements lie in the receiving hopper and weighing hopper and means for cutting off the discharge of grain into the latter. A new construction is also provided in the gates of the weighing hopper and in the means for recording the weight of the grain.

COMBINED CORN COOKING AND CANNING MACHINE.—L. S. FLECKENSTEIN, Easton, Md. Mr. Fleckenstein has provided by this invention an improved machine for cooking corn and canning the same. This machine is distinguished by its simplicity of construction, economy of manufacture and ease and efficiency of operation.

MACHINE FOR CUTTING VEGETABLE ROOTS.—H. WEBB, Ashton, Mich. The chief or distinguishing feature of this improved apparatus for cutting vegetable roots lies in the employment of a hollow, rotary drum, having an eccentric portion and a series of cutters arranged on the periphery of the same in a peculiar manner, whereby great advantages are attained.

MACHINE FOR HANDLING VEHICLES.—G. E. and J. S. MYERS, St. Joseph, Mo. These inventors employ two trucks of peculiar construction and two inclined rails for said trucks whereby the wheels of a vehicle may be raised from the ground by merely backing the vehicle onto the trucks. The vehicle is automatically released from the trucks in pulling it off the same, and the trucks are left in position for jacking up another without requiring any special manipulation.

PHOTOGRAPHIC SHUTTER.—W. F. FOLMER, New York, N. Y. Through an especial arrangement of this shutter the exposure automatically diminishes as it reaches the sky line, giving the foreground greater exposure than the sky. The exposure may be accurately controlled from the interior of the box and means are provided for setting the exposure opening through the medium of a scale upon the focusing glass.

Railway Improvements.

RAIL-JOINT.—C. C. OSENBAUGH and R. L. GIBSON, Remington, Penn. These inventors provide an improved joint for joining railway rails, bridge trusses and the like. The joint will grip the meeting ends of the rails without the use of bolts and nuts, and will permit the expansion and contraction of the rails without danger of buckling.

Vehicles and Their Accessories.

WHEEL.—A. A. VÉREL, 179 George Street, Glasgow, Scotland. The invention applies to wheels adapted for carriages of various descriptions and cycles, but may also be used for other purposes. It is more especially an improvement in that class of wheels in which some form of spring is interposed between the center or hub, and the spokes that extend to the rim or felley.

STORM-CURTAIN.—J. W. SIMMONS, Bloomington, Ind. The curtain may be readily adjusted to protect the occupant of a vehicle from stormy weather, and is so arranged that it may be fastened back, when not required for use, in such a manner as not to interfere with the lowering of the top. The curtain will also yield to the movements of the top when the vehicle is in motion.

Miscellaneous Inventions.

STOVE.—W. HEUERMANN, Sedalia, Mo. The invention provides improved means for forcing the circulation of the products of combustion in order to secure the maximum heating results therefrom. These means are embodied in a novel construction and combination of parts.

STOVEPIPE-HOLDER.—J. S. RHODES, East Las Vegas, New Mexico Ty. The stovepipe-holder is adjustable in its parts so as to adapt it for general service and permit its application to stovepipes of different diameters, and also enable its hooked engagement with chimney walls of different thicknesses, whereby to clamp and hold the pipe in an aperture in the chimney wall and prevent it from retrograde movement therein.

FOUNTAIN-PEN.—R. C. PAINE, Bethel, N. Y. The improved fountain-pen insures a ready and continuous flow of ink to the pen point and will automatically drain the pen point of all ink when the pen is held with the point upward. When the cap is screwed on, no leakage can take place, even though the pen be he carried point downward.

COMPOSITION FOR CLEANING AND PRESERVING METALS.—W. C. OBERWALDER, New York, N. Y. By means of this invention silver or other metals may not only be thoroughly and easily cleaned of discoloring oxides and other accumulations adhering thereto, but the subsequent formation of these oxides may be effectively prevented.

WHEELBARROW.—W. A. HOUSE and W. F. HOSKEN, Covington, Ky. The wheelbarrow is adapted for use in carrying articles of different sizes such as milk cans, barrels, stoves, etc. The handles are adjustable toward and from each other for the purpose of accommodating them to the different sizes of articles to be carried.

BOTTLE-NIPPLE.—PHILIP GAUSS, New York, N. Y. The nipple comprises a non-collapsible mouthpiece, so that the opening or duct through it cannot become closed by external pressure or by vacuum occurring in the bottle. The mouthpiece is oval in cross-section, adapting it for the child's mouth, and it is given a proper degree of elasticity.

FOLDABLE STOOL.—P. R. ANTON, Topeka, Kan. By this invention Mr. Anton provides a stool of novel construction which will afford a strong, light and comfortable seat when adjusted for use and which may be folded into a very compact package for storage or transportation.

STIRRUP-STRAP.—L. P. WELLMAN, West New York, N. J. Stirrup-straps as usually employed are made of leather, and in use the strap is doubled and hung on the saddle with the buckle end, forming a thick, unsightly bunch. The purpose of this invention is to overcome this fault by providing single straps, preferably made of metal in hinged sections. The lower portion of this strap holds the stirrup at an angle to the rider's foot and at an angle to the side of the animal.

SACK-RACE STRUCTURE.—J. J. WEGNER, Brooklyn, N. Y. This invention provides a new amusement in which cars appearing to carry sacks are adapted to travel up and down undulating tracks. The sack sections, which contain passengers, are pivotally mounted in the cars and are spring-controlled in two opposite directions, enabling the occupants by enegetic movements of their bodies to add to the velocity of the cars to a greater or less extent. This, if two adjacent tracks are provided, will permit parties traveling on one track to race with others moving upon an adjoining track.

FUNNEL.—J. DE ST. LEGIER, Hicksville, N. Y. The funnel or strainer is so constructed that the straining member may be quickly and conveniently secured in a straining position in the body of the funnel, and as readily secured when desired in a position which will leave unobstructed communication between the body and neck of the funnel.

SMOKE-CONSUMER.—W. T. KEOGH, New York, N. Y. This smoke-consumer belongs to the type in which steam is used. The construction is very simple and efficient, and does not contain any part which will readily be burned out. The smoke-consumer has also the advantage that it can be readily applied to machinery now in operation with comparatively few structural changes.

MEASURING DEVICE.—CHRISTIAN CHRISTENSEN, Escanaba, Mich. This device is more particularly designed for use of opticians and eye specialists to fit spectacles and eyeglasses by obtaining accurately the necessary measurements such as pupilary distance, temple distance, height or depth of the nose angle of the nosepiece, length of the temple, and width at the base of the nose—thus insuring proper fitting of the eyeglasses or spectacles to a wearer's face.

STRETCHER.—F. X. AIGNER, Jersey City, N. J. This sectional stretcher is so constructed that the body portion may be parted beneath a patient and the patient laid upon a bed without being turned or unduly jarred when the stretcher is removed. The construction is very simple, and the stretcher may be used with or without attached blankets.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 3031.—For makers of woodworking machinery for panelling.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 3032.—For the manufacturers of the Peerless Ice Cream Freezer.

For logging engines. J. S. Mundy, Newark, N. J.

Inquiry No. 3033.—For makers of Edison's patent steel.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 3034.—For makers of aluminium to do special work.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 3035.—For machinery for making spools and bobbins for factories.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3036.—For a spring or weight motor from 1 to 2 h. p.

WANTED.—Merchandise vending slot machines. Gene Nobles, Prescott, Arizona.

Inquiry No. 3037.—For machinery for making brick from sand and cement.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3038.—For an attachment for a stationary boiler to use crude or other oils as fuel instead of coal.

Die work, experimental work and novelties manufactured. American Hardware Mfg. Co., Ottawa, Ill.

Inquiry No. 3039.—For an oil burner for cooking and heating purposes.

We design and build special and automatic machinery for all purposes. The Amstutz-Osborn Company, Cleveland, Ohio.

Inquiry No. 3040.—For makers of machinery for mixing and bottling medicine.

Special and Automatic Machines built to drawings on contract. The Garvin Machine Co., 149 Varick, cor. Spring Streets., N. Y.

Inquiry No. 3041.—For makers of burners for crude petroleum to be fitted to a small, horizontal steam boiler.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 3042.—For makers of small brass or iron castings, such as curtain fixtures, etc.

Tools for sheet metal stamping, metal patterns, gear cutting and light machine work. Racine Machine and Tool Works, Racine, Wis.

Inquiry No. 3043.—For flat coil springs, such as are in spring tape measures or small clocks.

Patenteed inventors will hear of something to their interest by addressing the Universal Inventors' Union, 846 Ninth Avenue, New York.

Inquiry No. 3044.—For cloth such as is used for tape measures.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3045.—For stamped sheet metal goods, such as match boxes, etc.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3046.—For parties to manufacture a soap-bolding device.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers. 361 Broadway, N.Y.

Inquiry No. 3047.—For a dish-washing machine for a small household.

WANTED.—Second-hand screw cutting lathe. Second-hand electric motor, half horse power, alternating current, 104 volts, 60 cycles. W. A. Cornell, Pleasantville Station, N. Y.

Inquiry No. 3048.—For manufacturers of paper-making machinery.

FOREMAN BOILER MAKER WANTED.—First-class man wanted for a modern shop building marine and stationary boilers, and doing boiler and iron ship repairs. Applicants will please state age, experience, nationality, and give names of previous employers. This is a good position for a good man. Address P. O. Box, 2685, Boston.

Inquiry No. 3049.—For manufacturers of wood-engraving machines.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 3050.—For the address af the Richard Machine and Tool Co.

WANTED.—Capital to develop an invention in mining machinery. Only small sum need be risked to demonstrate. Immense field for business. A fortune to the right man. Address Capital, Box 773, New York.

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Inquiry No. 3053.—For makers of presses for pressing and punching paper to be used on flower bouquets.

Inquiry No. 3054.—For small wheels of special dimensions for revolving-top tables.

Inquiry No. 3055.—For a spring motor similar to clockwork to run a sewing machine or a small boat.

Inquiry No. 3056.—For machinery for calciming in several colors.

Inquiry No. 3057.—For parties to manufacture brass articles, such as nuts, bolts, etc.

Inquiry No. 3058.—For dealers in machinery and supplies for a broom factory.

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"Council Brand," for cigars, E. Travis..... 9,366
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A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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NEW BOOKS ETC.

A Hand Book for Apprenticed Machinists. Edited by Oscar J. Beale, Providence, R. I.: Brown & Sharpe Manufacturing Company. 16mo. Pp. 141.

This book is for learners in the use of machine tools, and is the outgrowth of the needs of the Brown & Sharpe Company in the instructing of apprentices. It was thought that there is too much uncertainty in depending upon oral instruction to impart the information in some detail which every apprentice is entitled to receive. An experimental edition of this book has been printed, and has proved useful. The present edition is carefully revised and enlarged, and in its present form should be still more useful. The book does not aim to take the place of the engineers' pocketbooks already published. It is simply what it purports to be, an elementary treatise for apprentices.

V. Löbell's Jahresberichte über die Veränderungen und Fortschritte im Militärwesen. XXVIII. Jahrgang. Bericht für das Jahr, 1901. Unter Mitwirkung zahlreicher Offiziere herausgegeben von v. Pelet-Narbonne, Generalleutnant z. D. Mit einem Bildniss des verstorbenen Obersten v. Loebell und fünf Skizzen im Text. Berlin: E. S. Mittler & Sohn.

The last annual volume of von Löbell's Jahresberichte bears as a frontispiece a portrait of the late Col. von Löbell, the founder of these famous annual military reports. Of particular importance among the many subjects discussed in the volume are the military operations of the allied forces in the Far East. The first part of the report is devoted to the discussion of the development during the past year of the armies of Europe and the United States. The second part of the book is devoted to the discussion of military subjects, among which may be mentioned cavalry and infantry tactics, field ordnance, scouting service, etc.

Small Dynamos and Motors. How to Make, Test and Repair Them. By F. E. Powell. Fully illustrated. London: Dawbarn & Ward, Ltd. Pp. 76.

This little book is intended for those who have sufficient elementary knowledge of electrical engineering, and who wish to try their hand at the designing and building of small dynamos or motors. The work ought to present no difficulty to the amateur of average intelligence who takes a lively interest in the subject and has some slight grasp of draftsmanship in addition to constructive talent.

Le Phénomène de Kerr. Par E. Néculéa. C. Naud. 1902. 16mo. Pp. 91. Price 50 cents.

M. Néculéa's monograph is devoted to a discussion of the phenomena of double electric refraction, which was first discovered by Kerr in 1875. The particular phenomenon which M. Néculéa describes must be distinguished from the phenomenon of double electric refraction, with which Mr. Kerr also acquainted the scientific world. With this latter phenomenon the present work has nothing whatever to do. So far as the first is concerned, its existence has been considered doubtful, for the conditions under which it has been studied in the experiments made by Kerr, Roentgen, Quincke and Brongersna never seemed sufficiently conclusive to many scientists to decide whether the double refraction observed is a direct effect, due to dielectric causes, or simply a secondary effect resulting from the heating of solid or liquid dielectrics. In the opinion of the author, Kerr's phenomenon has a most decided existence—an existence which he has proven by a very earnest and thorough discussion. An excellent bibliography accompanies his work.

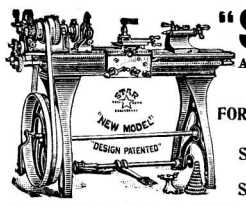
Workshop Wrinkles for Decorators, Painters, Etc. Edited by William Norman Brown. London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1901. 16mo. Pp. xv-127. Price $1.

This is a little book that should be of service where often a certain job must be done in a hurry, and no one knows exactly how to do it. The subjects treated are "Decorating," "Paint," "Paper Hanging," "Waterproofing," "Varnishing," etc. Since the information is arranged alphabetically under heads, it can be easily referred to.

The Story of Creation. By Gibson C. Andrews. Greenville, Va. 1900. Pp. 232.

Ammonia and its Compounds. Their Manufacture and Uses. By Camille Vincent. Translated by M. J. Salter. London: Scott, Greenwood & Co. 1901. New York: D. Van Nostrand Company. Large 8vo. Pp. xii-114. Price $2.

Although Prof. Camille Vincent's little treatise on ammonia describes primarily French methods for the preparation of ammonia and ammonium salts from various waste and raw products, it should be of service in the admirable English form with which Mr. Salter has provided us. Ammonia is of considerable use in the industrial arts and of late its application in agriculture and refrigeration has increased in importance to such an extent that chemical manufacturers have been induced to pay more attention to methods and means for producing it in a comparatively pure condition on a large scale. Although the book is admirably printed, its illustrations might be better. Evidently they were taken from the French edition.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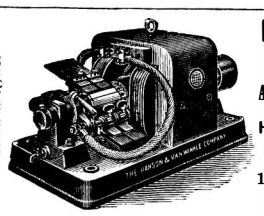
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VOL. 33.
JANUARY--JUNE, 1902.
278 Illustrations. 120 Pages, 6 Tint-Blocks.
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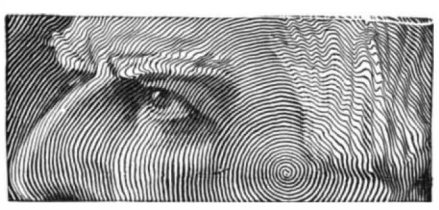

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(8664) G. C. W. asks: An electric company charges for current 10 cents per kilowatt-hour. How many kilowatt-hours are required to run ten 110-volt 16 candle power lamps 10 hours? Also, how many for a 5 horse power motor, 110 volts, and a 220-volt motor for the same time? A. A 16 candle power lamp at 110 volts may be assumed to take one-half an ampere, and thus use 55 watts per hour. Ten lamps will use 550 watts, and in 10 hours will use 5,500 watts, or 5.5 kilowatt hours, which at 10 cents per kilowatt hour will cost 55 cents. An electrical horse power is 746 watts: 5 horse power for one hour will use 3,730 watts, and in ten hours will use 37,300 watts, or 37.3 kilowatt hours. This at ten cents per kilowatt hour will cost $3.73. It is common to reckon 11-3 horse power per kilowatt hour. If reckoned thus, the bill would be $3.75 The voltage does not affect the horse power If the current were supplied at 220 volts, the amperes would be halved, but the watts would be the same, and the bill calculated would be the same. The real bill as found from a meter might be very different from this. The motor does not run at best efficiency unless it runs at full load. If it is not using 5 horse power, it takes more than the proportionate part of 5 horse power to drive it: how much, it is not possible to say in general terms.

(8665) E. A. asks: During a rainstorm a click, and sometimes a very brief ring of a telephone bell is frequently audible, and is always coincident with a heavy stroke of lightning. It seems very evident that the click of the bell is due to the lightning being coincident with it, but how does the lightning cause the bell to click? A. The ringing of the telephone bell when a discharge of lightning occurs in its vicinity is explained by induction. The electric discharge affects the wire in the same manner as the discharge of a battery current through the wire would do. The magnet attracts the armature, and the bell rings. It is a frequent occurrence with both telegraph and telephone lines.

(8666) J. D. A. writes: On several occasions I have read in the answers to questions of your valuable paper, that lightning is due to atmospheric disturbances. I have also noticed that this theory is advanced in most of the electrical books that have come to my hands. Though it is undeniable that there must be some disturbance, yet such theory does not seem to me entirely satisfactory, for it is open to the question, What is the nature of such disturbance? I am of the opinion (and the more I study the subject the more I adhere to it) that lightning is caused by the heat thrown off in the sudden condensation of the water vapors suspended in the atmosphere: the condensation being caused by the atmospheric pressure, and taking place whenever said pressure becomes greater than the expansive force of said vapors. Is not this possible? I would like to know your opinion on this theory, either through the columns of your paper or otherwise. A. While the condensation of water vapor in the air may be concerned in the production of electrification of the water drops in the air, it is not easy to see how the pressure of the air can be any different from the pressure of the vapor of water in the same place in the air, unless the law of Newton is untrue, that action and reaction are equal. The production of a flash of lightning is not yet accounted for by any theory, and we shall have to wait for more knowledge than we have to explain this phenomenon.

(8667) S. M. D. asks: Is there any limit to the distance that a certain amount of electricity will travel over wire, that is, will a weak battery send electricity as far as a strong battery? A. There is a limit of distance to which a small amount of electric current can affect an instrument so that it can be perceived. This is at a less distance than a strong current can affect the same instrument. In this sense a weak current cannot travel as far as a strong one over a wire. A weak battery cannot produce the same effect through a mile of wire as a strong battery can; but if we had more delicate instruments we might still detect the weak current much farther than we can at present. It is not so much the defect of the current as of the instruments for observing it.

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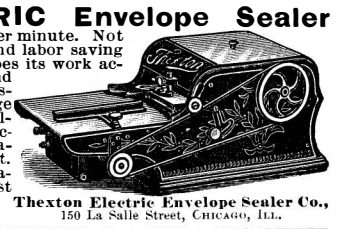
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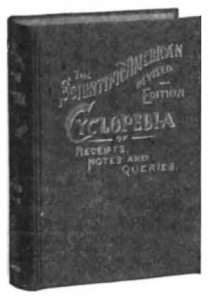
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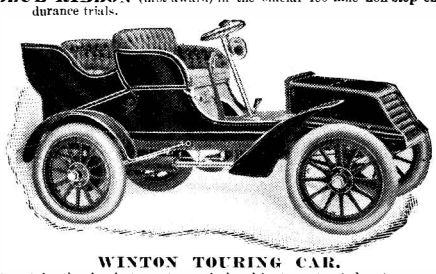

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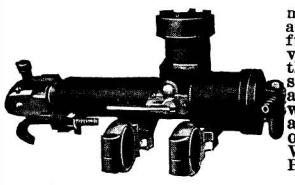

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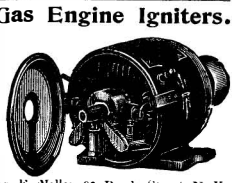

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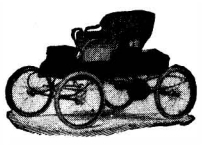

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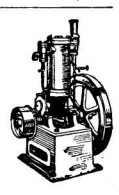

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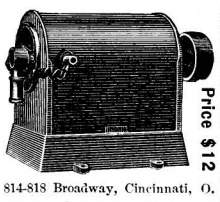

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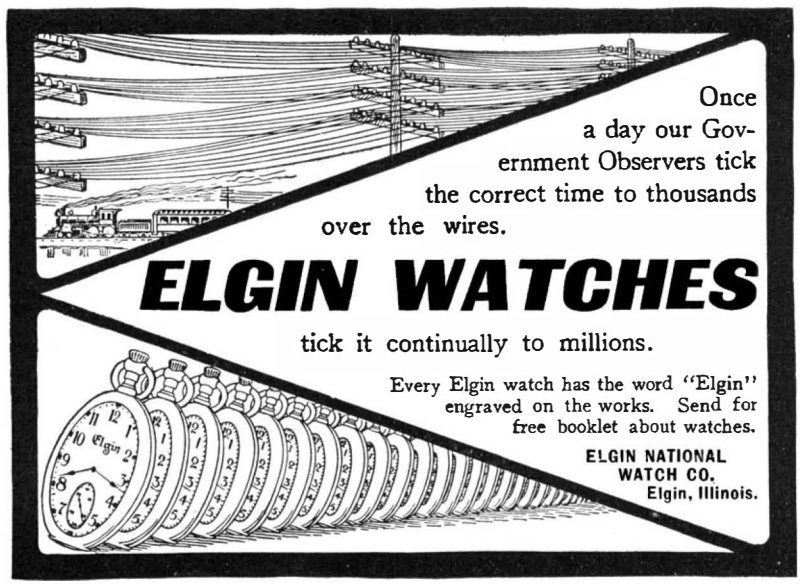
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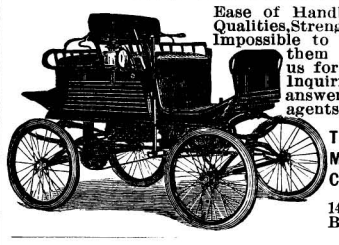

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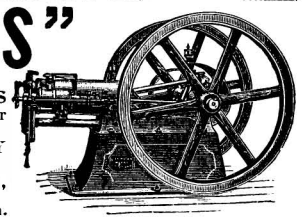

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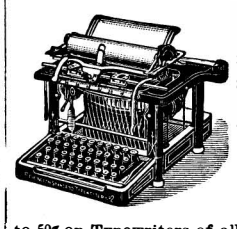

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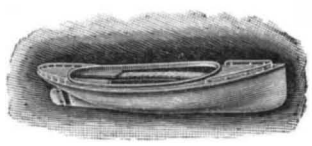

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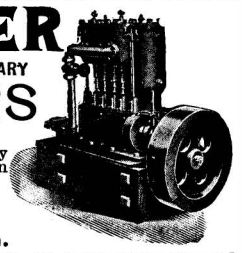

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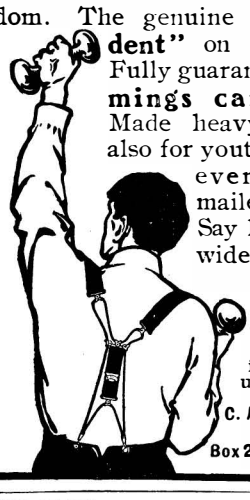

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